THE MIDLAND NATURALIST

THE JOURNAL OF THE "MIDLAND UNION OF NATURAL HISTORY SOCIETIES," WITH WHICH IS INCORPORATED THE ENTIRE TRANSACTIONS OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

EDITED BY

E. W. BADGER & W. HILLHOUSE, M.A., F.L.S.

"Come forth into the light of things,
Let nature be your teacher."
Wordsworth.

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ILLUSTRATIONS IN VOLUME XI.

PREFACE.

The completion of another volume of the "Midland Naturalist" once more gives us an opportunity, of which we gladly avail ourselves, of offering to all our fellow-workers a full meed of thanks for the kindly assistance they have rendered us. Amongst our contributors it gives us especial pleasure to welcome some new-comers; while, at the same time, many who have worked with us for years have still continued their valued and valuable co-operation. And to these we wish to add another group of contributors, whose labours are periodical and unostentatious, namely, the various secretaries through whose thoughtful care the reports of the meetings of the local Natural History Societies are provided for our pages.

Still, however, we want recruits. Whether the restlessness of foreign politics has affected us, or not, we cannot say, but we want to raise our peace footing to something considerably above its present strength, and our reserves are not nearly large enough for our wishes. No doubt a large increase in the ranks of our fellow-workers would diminish our own responsibilities, but we are quite prepared to face this contingency with equanimity.

Particularly we hope to enlist the sympathies and aid of more secretaries of Societies, so many of whom (belonging to the M. U. of N. H. S.) take no part in our work. If they would all make a point of sending to us reports of the meetings of their respective Societies, and would contribute, if only occasionally, some paper communicated to them, they would furnish a steady and reliable source of supply. Specially we would ask for the annual addresses of the various presidents, it being borne in mind that their appearance in the "Midland Naturalist" in no way affects disadvantageously, but rather facilitates, their separate publication, should this be desired. These addresses are generally of interest far beyond the circle to which they are delivered, and, as our experience has shown, would form a welcome and attractive feature in the pages of the "Midland Naturalist."

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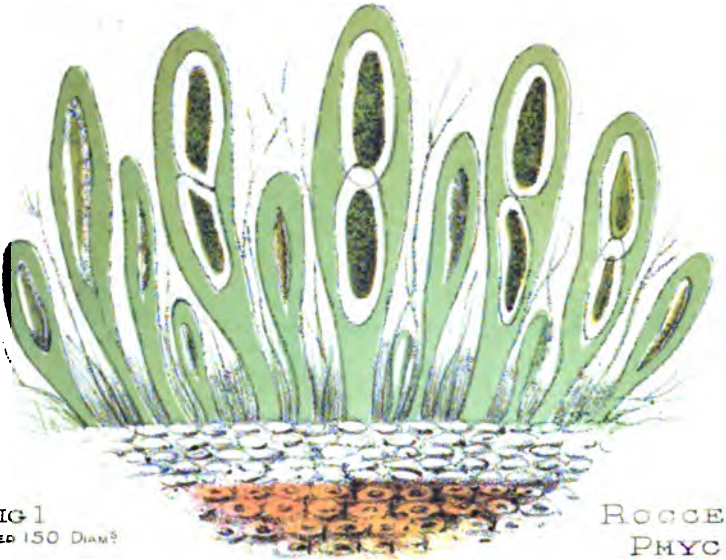

Fig 1
Magnified 150 Diam^s

Roccella
Phycopsis.

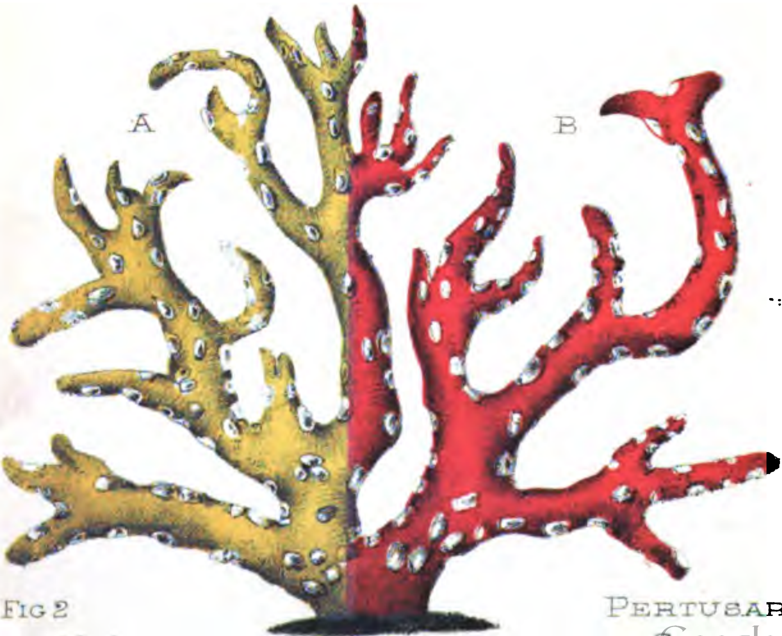

Fig 2
Magnified 4 Diam^s

Pertusaria
Communis

Colour Reaction

THE MIDLAND NATURALIST.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

COLOUR-REACTION:

ITS USE TO THE MICROSCOPIST & TO THE BIOLOGIST.*

BY W. H. WILKINSON,

HON. SEC. OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

The rapid progress which has been made in nearly every branch of science during the last few years, is recognised by every student of Nature, and must lead to still further advance in the near future. Every fresh discovery made, and every new fact recorded, but opens a new door for fresh exploration and paves the way for new observation.

Thus the microscopist is constantly being enriched by the advance of optical science, and gladly avails himself of the improvements in the illumination of the object and the power and penetration of his lenses, and, as we are confidently told, the employment of the new German glass gives still further promise in this direction.

But the biologist not only needs all this, but more, and, while eagerly taking advantage of the improvements in optics, he applies to chemistry for acids and other solutions to disintegrate and separate and clear the various tissues he has to study. Thus when he has prepared delicate and thin sections, the chemist finds him various stains, which not only make his preparations look beautiful, especially in double

DESCRIPTION OF PLATE I.

FIGURE 1.—Thin section of a portion of an apothecium of a Lichen, *Pertusaria communis*, magnified 150 diameters, showing the asci and spores under the action of iodine.

FIGURE 2.—Thallus of Lichen, *Roccella phycopsis*, magnified 4 diameters.

A. Natural Colour.

B. Changed to Red by the action of Hypochlorite of Lime.

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* Transactions of the Birmingham Natural History and Microscopical Society, Microscopical Section, April 5th, 1887.

staining, when either the contrasts or the blending of the colours are so effective, but which assist him in tracing the continuation of a given tissue or the course of a vascular bundle, or reveal the structure of the otherwise too transparent tissue. The advantages of mounting serial sections are also much enhanced by the delicate shades of colour produced by a careful use of double stains. Of course for mounting, the colours produced require to be permanent, but transient colours may be equally valuable as a test to the biologist.

Unstained sections are always the truest to Nature, and in many instances are sufficient for the biologist; but if no stains had been used, our present advance in the knowledge of the structure of the tissues composing living matter could never have been attained; as sometimes even a cell-wall will be so delicate and transparent that it requires the most careful treatment to reveal its presence.

Single stains are rendered valuable, as they colour some portions only of the structure while the other parts remain uncoloured; for instance, if the leaf of a Fern, *Pteris tremula*, after being "bleached," were submitted to the action of a carmine dye, the beautifully reticulated epidermis would remain unchanged, while the sori, spiral springs, and spores would all be stained carmine, and so at once easily recognised.

The foundation of double staining is that it is found from experiment that different colours affect different portions of the section, so that, for example, carmine and light green, being complementary to each other, please the eye; while each colour reveals its own portion of the structure.

Other double stains are needed, as some substances do not take the ordinary dyes, *i.e.*, a section of the Lichen, *Lecidea sanguinaria*, while unaffected by the usual dyes, may have its fruit (apothecia) coloured by an aqueous solution of Morrell's coral-red ink, and the remainder by an alcoholic solution of methyl green, giving brilliant results.

Besides the large number of useful aniline dyes now in the market, sections may be stained by many special methods which the worker will have to find out for himself. Sections treated with an iron solution first, then by cyanide of potassium, will develope a fine Prussian blue. They may also be coloured brown by soaking them in a solution of nitrate of silver, and, after the mounting is complete, by exposing them to the sun, when the silver will turn brown, and so reveal the portions it has penetrated.

It must be noted that in staining it is requisite to make the sections sufficiently dark to stand the subsequent process of mounting, but if too dark the delicate contrasts will be lost.

Perhaps in no department of biology is colour-reaction of more practical use than in the study of the Lichens. Nylander was one of the first to call attention to its value, but the principle had many a battle and many a struggle before it was accepted, and even now it is looked upon rather sceptically by some. Dr. Lauder Lindsay, having tried many hundreds of experiments, came to the conclusion that "there was nothing in it," as may be seen from the following extract from one of his papers on this subject:—

"These reactions occur of every degree of intensity, from the faintest and most obscure to the most brilliant and deepest. But in a far larger proportion of cases no reaction is exhibited at all; and in species in which it is usually developed it is capricious in the extreme—its development being apparently determined by the most trivial circumstances affecting (*e.g.*) the freshness or other condition on the one hand, and the reagent on the other. By reason of this extreme inconstancy of result, chemical characters cannot, I think, be relied on as furnishing a means of *determining species*. Certainly they have never afforded me any aid in this respect." *

But, fortunately, Dr. Lauder Lindsay recorded his experiments, and so they have been useful to others, although not to himself. And after many careful experiments, it was established that, given the same conditions, the same results might be looked for, so that after long waiting, *colour-reaction* has at last become generally accepted as a Lichen test. Thus Leighton in England, Nylander on the Continent, and many others, accept the principle, and use it largely and successfully in their work.

There are three principal reagents used:—

Iodine	= I.	generally giving	blue reactions.
Hypochlorite of Lime	= C.	,, ,,	red ,,
Hydrate of Potash	= K.	,, ,,	yellow ,,

Iodine (as is well known in chemistry) possesses the property of turning starch and amyloid bodies blue, and so is generally applied to sections of the apothecia, when the asci are transformed from their plain semi-transparency to a delicate blue, thus rendering them at once visible, and their forms and positions may be easily ascertained. A reference to figure 1, plate 1, may render this more easily understood. The figure represents a section of part of an apothecium of *Pertusaria communis* × 150, which when first cut is colourless,

* Transactions Bot. Society, Edinburgh, for 1869, p. 84.

but after the application of a weak solution of iodine, the beautiful blue colour is developed, as shown in the figure. This colour is transient and would fade in a hour in daylight, but may be kept much longer in the dark.

The lime and potash tests are generally used on the thallus or leaf-like portion of the Lichen, sometimes on the surface only, and at others on the medullary layer. The results may be negative, producing no change in some species, while others will give different colour-reactions, thus affording much help in determining species.

A glance at figure 2, plate 1, will show at once the striking effect of an application of the lime test C. to the thallus of *Roccella phycopsis*, the portion A representing its natural colour, while B shows the red colour produced by a touch of this solution. It may further be noticed that the soredia (those white patches scattered over its surface) are not affected in this species by the C. solution, while in *Roccella fuciformis*, a species very near it, the thallus itself is untouched by an application of the C. solution, while the soredia are coloured red. It will now be clear how useful this test is in deciding to which of these species a specimen belongs.

Leighton and some others not only use these tests in determining species, but also as a sufficient ground for forming new "varieties," or even new species, as, to quote from Leighton's Lichen Flora, "*Cladonia Flörkeana* var. *bacillaris*, K—, C—. Hitherto confused by external aspect and characters alone, with *Cladonia macilenta*, but separated by different reaction K yellow, C—."

While the classification of Lichens is generally based upon the spores, Leighton had found it more useful in *Lecanora* and *Cladonia* to make the colour-reaction of the thallus the basis of division, so that by carefully observing every effect of these colour-reagents a great help has been gained in the somewhat difficult study of the Lichens.

It may not be generally known that the litmus test papers, to be bought in almost any chemist's shop, are made from the Lichens of the genus *Roccella*. And it is probable that colour-reaction will before long form one of the standard tests of the biological laboratory.

In the far greater number of my own trials the results have proved the accuracy of Leighton's tests, and many times have I been able to name a Lichen which would have remained useless and undetermined but for the colour-reaction.

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S.

(Continued from Vol. X., page 309).

The distribution of tannin in winter stems has been described by Sanio* in a few selected cases. In its general distribution, as seen in my own investigations, it is met with alike in assimilating tissues, such as leaves and cortex, and in storage tissues, such as medullary rays and pith in winter, and in the tissues of the leaf bases from which deciduous leaves have fallen or are about to fall. While generally present in the cell-sap of nearly every cell of the tissue concerned, tannin not infrequently has a definite distribution, as for example in vertical rows of elongated cells in the soft bast of *Phaseolus multiflorus* (kidney bean), in special tubular tannin vesicles of considerable length in the cortex and outer pith of *Sambucus nigra* (elder), and, together with starch, in cells forming a reticulum amongst the inner pith cells of very many dicotyledonous trees. Like starch, it is far less common in the aerial stems of Monocotyledons. This constant association of starch and tannin is curiously substantiated by Ebermayer:—"Alle guten Gerberinden sind ziemlich reich an Stärkemehl."† In general terms, my observations on the distribution of tannin tend to show that its presence in living tissues may be classified into—

(1) In cells containing protoplasm and little starch, or starch in minute grains;
(2) In cells containing starch, as reserve stores, and little protoplasm.

Cases of the first are generally cortical cells, and cells of the soft bast and bast rays. In these the whole contents of the cell, under the action of potassium bichromate, tend to collect into either a large ball, or a number of balls, of clear, bright, oily looking substance, highly refractive. In these cases it is probably always dissolved in the cell-sap, and in the interior of the protoplasmic body of the cell; under the action of the reagent this latter is killed, and more or less contracted; the tannin becomes partially diffused throughout the protoplasmic mass, partly passes outside it; the balls and masses formed by the reagent may, therefore, involve

* *Sanio*, "Einige Beobachtungen," u.s.w.; Bot. Zeit., 1863.
† *Ebermayer*, Phys. Chemie der Pflanzen, 1882, Bd. I., p. 404.

more or less completely the whole protoplasmic body of the cell. Often there is no contraction of the protoplasmic body, and the whole contents of the cell, excepting the thin primordial utricle closely applied to the cell-wall, are highly coloured (*e.g.*, leaf and cortical cells of *Prunus Laurocerasus*, *Ilex aquifolium*). Where oil drops are present, *e.g.*, in *Ilex aquifolium*, these, in such cases, show brightly through the yellow-brown mass.*

In the second case, where the cells contain large quantities of starch, as met with in the medullary rays of the wood, the cells of the pith-crown, many cells, isolated or in a reticulum, of the central pith, and the wood cells (where tannin is comparatively infrequent), the tannin, originally in solution in the cell-sap, becomes, as the latter is displaced by the accumulating starch grains, firstly more and more concentrated, penetrates often, as already noted, the starch grains themselves, and when treated with potassium bichromate commonly the whole mass of the cell-contents collects into one very dark brown ball, in which the starch grains are barely or not at all distinguishable; sometimes it forms an irregular brown granular-looking reticulum, in the meshes of which the starch grains can easily be seen.

Wigand is partially correct when he says that when a plant contains tannin and starch, the two are usually not only in the same tissues, but also in the same cells; but he is far from correct when he says that they are not, as a rule, present simultaneously.

On the other hand, in many cells, particularly in those which in spring have been emptied of their starch, but also in many cortical cells, particularly in the "exhausted" plants hereafter spoken of, the potassium bichromate does not form these clear masses with the tannin, but instead we get irregular collections of blackish brown disintegrated looking fragments or small lumps, especially collecting round the outer parts of the cell-lumen, leaving the centre quite free. This difference is probably significant.

* During life, probably, the protoplasm is not so freely permeable to tannin as is generally assumed. After death, and use of iron reagents, I have sometimes found the nucleus in tannin-containing cells, as well as in the neighbouring cells, beautifully stained from infiltration of tannin, *e.g.*, in the rhizome of *Botrychium lunaria*. By soaking sections of cellular tissue, free of protoplasm, *e.g.*, sections from a fallen leaf-stalk, in a solution of tannin, and then testing with iron salts, the cell-wall, too, is often well stained, a phenomenon which I have not noticed during life. This is probably the explanation of Hartig's, "Wandungszustand" of tannin in *Salisburia*.

In no case is there noticeable, as Wigand asserts, a diminution of tannin in early winter as starch accumulates. The explanation of his observations is probably to be found in the physically necessary concentration of the tannin in winter, owing to the space occupied in many of the cells by the starch accumulated there. There is no sign that the starch is formed at the expense of the tannin. On the other hand, in spring, with the consumption of starch in the processes of growth, I have not, with Wigand, noticed any marked increase in the tannin contents of cells in which it already existed, or increase in the number of those cells in any storage part. The filling of the cell with cell-sap restores the tannin, however, to a more dilute form, the quantity being possibly increased somewhat.

In the newly formed spring elongation of the axis, tannin makes its appearance in quantity dependent on the amount of growth. Were it a food material, one would expect it, like starch, to disappear from the older tissues. Of this, however, there is no sign. The tissues of the bud are often crowded* with it, usually, however, excepting the strings of procambium.

It will be seen from the above observations that, although I dispute the conclusions of Hartig and of Wigand, there is little or no constructive evidence to show that tannin is not a stage in the metabolism of the food materials, such for instance as an intermediate product between starch and glucose, and more or less closely allied to the latter. Evidence derived from chemical and microchemical reactions points to a close affinity between sugar and tannin. Experiments conducted, however, with the tannin of chemists are of no use in determining a physiological question such as this. Such tannin, I believe, always contains a certain amount of free glucose, and perhaps another proportion very loosely combined. The fact that some tannins can, by boiling with dilute acids or alkalis, be broken up into glucose and something else, is of chief interest as suggesting, as my own experience seems strongly to do, that the glucose reaction of Sachs† is not a pure test for glucose, when tannin also is present in the tissues. At the same time, Pfeffer's contention that tannin is not so broken up in the tissues, because the "something else" is so rarely found in the vegetable kingdom would, it appears to me, only be valid

* I do not here refer merely to the bud scales, in which tannin is in most cases exceedingly abundant.

† *Sachs*. Flora, 1862, p. 289.

on the assumption that this other product is not itself capable of immediate subsequent decomposition or recombination.

Leaving, therefore, the inherent capabilities of the tannins to be discussed by the chemists, I have proposed to myself the following :—

If tannin be a food material, then, like other food materials, it will, in case of need, be used as food.

This I have submitted to experimental evidence by three parallel series of investigations.

(1) Plants, or portions of plants, which from previous investigation I knew to richly contain tannin, were allowed to grow under such conditions that assimilation was impossible.

(2) Seeds were germinated in darkness, in order to see whether the tannin then formed was used up in further growth.

(3) Corms were investigated, in order to see whether the tannin which they contained was transferred to the newly formed corm, with the transfer of the starch.

Potassium bichromate was used in all these investigations, and the preparations made at different times actually compared with one another. The following is a summary of the experimental evidence thus afforded :—

Corm of *Crocus*. May 28th.—The old corm contained starch throughout its tissue, but mostly in scattered "heaps" of grains, no cell being full, except near the part of union with the new corm, hereafter called the "union base." Tannin is present in isolated cells, completely filling them with a large brown to very dark brown mass, especially abundant in the cells near the union base, less numerous as you get more remote from this. Many of the conducting cells of the vascular bundles are also full.

The young corm has its cells immensely crowded with starch, mostly in small grains. Treated fresh with iron-salt, it apparently has no tannin, but potassium bichromate shows isolated grains, less frequent than in the old corm, and in all cases contained in cells which contain starch. Near the union base it also is much more abundant. In the young corm the tannin does not fill the cell with one mass, excepting in many of the cells near the union base; but is in the form of several small, often irregular, globules or balls.

June 25th.—The old corm is shrivelled, and entirely free of starch. The distribution of tannin shows no change whatever. There is no apparent reduction in quantity. The

young corm shows increase in the quantity of tannin, though not to any marked extent. Its distribution is unchanged.

In the corm of *Crocus* the tannin is not, therefore, like starch, transferred from the part whose function is ended to that where its utility can be continued.

Similar evidence is given by *Arum maculatum*, and the bulb of *Narcissus Pseudo-narcissus*.

Æsculus Hippocastanum. April 18th.—Shows abundant tannin in the cortex of twigs in scattered cells. All cells of phellogen, and most of phelloderm full; a few of the bast ray cells full, as are many cells of the soft bast; a few cells of the wood rays; scattered cells in the pith-crown full, and some cells in central pith. In the leaf-traces of previous year's leaves, the whole of the parenchyma of the vascular bundle is full. The cells underlying the cork layer on the scar are full; none in the cork layer itself; but some of the cells of the parenchyma of the leaf-stalk, which still adhere outside the scar, contain tannin.

On this and the succeeding plants the method of investigation adopted was to enclose branches in dark frames, with provision for ventilation, and thus leave them to grow, but not to assimilate.

The experiments closed on July 21st. The tannin had undergone no diminution whatever in the stem of the last year, although the starch was quite exhausted. This year's stem, however, showed an almost complete absence of starch, but tannin perhaps more than in the normally grown stem of the year. The tissues of the bud and pith are especially full of it.

On *Pavia rubra* (smooth-fruited red-flowered horse chestnut), I experimented also with flowering axes. The flowering and fruiting proceeded apparently almost normally; but when the fruits were approaching half-an-inch in diameter, most indeed much sooner, they fell off. They, and all the tissues of the peduncle, this year's and last year's stems showed tannin, but no diminution in the last year's stem.

Similar evidence is given by *Quercus pedunculata*, of which, however, I could not quite exhaust the starch, *Pyrus Aucuparia*, and *Syringa vulgaris*.

I investigated also *Ilex aquifolium* and *Rhododendron* as types of the evergreen, but did not succeed in exhausting the supplies of starch, notwithstanding the free flowering and subsequent active growth of the latter species.

Pinus sylvestris (April 18th), in which plant Schell had seen the diminution of tannin in the spring, I carefully investigated. Last year's stem contains pretty abundant tannin in the outer cortex, and the cells around the resin

passages, moderately in the other cortical cells, considerable quantity in the bast, especially the outer bast, and a fair quantity in the pith. The young tissues of the bud have nearly every cell full; the bud scales are full.

For some time, about every week, I examined this stem; there was an undoubted diminution of the tannin; (1) in the bast, (2) in the cortex, (3) in the tissues succeeding from the bud; the bud itself remained full. Testing the stem with alkanet, showed that this decrease of tannin proceeded *pari passu*, with an increase in the amount of resin; the cells surrounding the resin ducts always showed the free presence of tannin.

According to Schell, starch and oil are wanting in the stem of *Pinus sylvestris*. This is not entirely the case. A few of the ray cells, both in wood and bast (on November 24th), contained starch in very small elongated grains. Some outer cells of the pith contained much larger grains, tending to kidney shape; many of the cells surrounding the resin passages of the wood (not of the cortex) also contain starch. On the other hand, most of the cells of the cortical tissue and bast contain a considerable amount of glucose, though this may be partly produced by the decomposition of the tannin in the reaction.

The tannin of *Pinus sylvestris* therefore may have relations with the copious resin formation of spring, but not with the building of new tissues.

I have not investigated *Larix europæa*, where Schell also says tannin is used as food material.

The rhizomes of *Scolopendrium vulgare* and of *Nephrodium* sp. showed (April 21st) abundant tannin in the starch parenchyma, as well as in the parenchyma of the vascular bundles; with further development this does not disappear or diminish, but seems rather to increase.

Fuchsia (hardy out-door) showed, May 30th, its root stock and young stems alike with abundant tannin. Made to grow in the dark, its tannin showed no signs of diminution, even when the starch was quite exhausted, and the plant gradually died from exhaustion.

Young plants of *Fuchsia* grown in a stove, and forced to grow in the dark from May 28th till complete exhaustion (with various specimens from June 28th to July 17th) showed no apparent diminution in the tannin contents.

Digitalis purpurea also, grown under a dark shade from May 23rd to June 19th, showed no diminution in the tannin present or once formed, whether in its root-stock, or in its stem (in which the tannin is mostly found in the angles of

the stem decurrent from the leaves). In the root-stock, however, which is very rich in (with potassium bichromate) clusters of minute globules, these globules amalgamated and altered their arrangement in such a way as at first to give the impression that the tannin had considerably diminished.

(To be continued.)

FUNGUS EATING.*

BY W. B. GROVE, B.A.

The test of an educated Englishman is his readiness to eat a well-cooked toad-stool. Observe, his "readiness" to eat, not his eating—and note also the "well-cooked." This apparent paradox is, after all, but a special instance of the self-evident theorem that superstition varies inversely as education.

To recommend to a rustic, who has reached the ordinary high-water mark of agricultural instruction, that he should use a little of that vast store of food which rots at his very doors, is to call forth a stare of contemptuous amazement, or a smile of superior disdain. *Omne ignotum pro horrifico.* "What! eat them pisonous things! It's flyin' in the face of natur'," who created toad-stools, forsooth, merely to be kicked.

A few countrymen have heard tell that "furriners" do not despise such food; but then "furriners" devour all sorts of nasty things. In one or two parts of the Midland Counties, certain of these rural persons have actually dared to eat something other than the common mushroom. Its near ally, the Horse-Mushroom, is dignified in the northern part of Warwickshire, and perhaps elsewhere, under the title of *the* Champignon; and is eaten by the Agamemnons and Hectors of the district, probably with secret trembling, but with a heroism worthy of another epic. The Champignon of cryptogamic botanists is, of course, a widely different species; but, as these village wiseacres knew of only two names for edible fungi, and the mushroom had already appropriated the one, they had naturally no resource but to apply the term Champignon to the other. The two species are, however, so much alike, that the rustic eye probably differentiates the Horse-Mushroom merely by its greater size. A mushroom rarely exceeds five inches in diameter, while the Champignon may reach twelve or more; the latter never has the bright

* "An Elementary Text Book of British Fungi." Illustrated. By W. D. Hay. London: Swan, Sonnenschein, Lowrey and Co. 1887.

salmon-pink gills of the former and its gills are browner at maturity, while its flesh is thicker and more substantial. In flavour they are similar, but not the same; one who has tried them both can readily distinguish them by that alone.

The richer sort are also fungus-eaters, in a similar pettifogging way. Truffles and Morells, bought at a fancy price from the Italian warehouseman, are fit to set before a prince, but those which his servants might gather from his own fields and parks he must never dare to touch. The inanity, the stupid malignancy of the distinction which thus elevates one particular species of fungus on a saintly pedestal above the rest, and saith: "This shalt thou eat and none other," would be a puzzle hard of explanation, if we did not know that the average British mind is intensely superstitious, while it thinks itself intensely practical. The guilt lies mainly on the shoulders of the man who first bestowed on fungi the nickname, "Toad-stools." Give a dog a bad name, and you know the consequences. The toad has an evil reputation.

Some people are fond of saying that toad-stools have a poisonous look. The main idea of this statement, so far as it has any idea at all, seems to be that bright colours are intended as a warning—"Touch-me-not." How little truth there is in the notion every fungus-eater knows, for those who hold it place the luscious Chantarelle, and the Delicious Lactare, under the same ban as the deadly Fly Agaric. What can be nicer and more enticing than the pure white flesh of a well-grown Giant Puffball; yet our country clodhoppers can find no better use for these pounds of vegetable sweet-bread, than to throw them at one another's heads.

The question of fungus eating is usually regarded as a fad of no more importance than as it furnishes an amusement to a few harmless enthusiasts. But this is not so. There have been circumstances, and may be again, in which it would be of national importance. In the great Irish famine, thousands of ignorant peasants starved, while tons of nutritious dainties covered the land around their cabins. Potatoes and butter-milk, even when plentiful, are not such delicacies that those who are compelled to live on them should neglect the relish which lies so ready to their hands.

Among the most recent attempts which have been made to extend the eating of fungi is the book which forms the subject of this notice. The author possesses certain qualifications for his task, which, if they had been rightly used, would have produced an admirable result. His knowledge of the esculent species, judging by his own account, is more

extensive than perhaps any other Englishman could boast; and moreover there seems to be no reason to suppose that he has much exaggerated this knowledge. At any rate, he mostly tells you, at first hand, what has been his own experience, and thus his work differs from many writings that have previously appeared, which merely tell us over again what we can find in other books.

Another advantage which the writer possesses, is that he evidently does not belong to the clique which rules the mycological roast—or rather, stew—in this country. As he says: "It has never been my privilege, as yet, to meet with any person versed in mycology, from whom I could derive instruction." There is thus a freshness and a breezy originality about what he writes, which is both interesting and bracing. He exhibits a disregard of the common prejudices of mycologists which is almost sublime. His passion for alphabetical arrangement, for instance, leads him to mix up unallied species in the fashion which popular writers usually, but erroneously, imagine to be more suitable for their audience.

Mr. Hay's great desire is to popularise the eating of fungi, although the title of his book is so worded as to give no hint of his design. For this purpose he describes, in language which he tries hard to render simple, all the British fungi which can by any stretch of imagination be considered esculent, together with some which are not British, and some which, even if they be considered eatable, offer scarcely anything tangible to eat. The latter he prettily names "Jelly-sprouts." Then, *per contra*, comes a list of the chief poisonous species, so that, if the searcher after novelties should find himself suddenly taken ill, he may know what name to apply to the author of the mischief.

Two of the most important parts of the book are chapter vii., where notes are given "On some common species of eatable mushrooms," and Appendix B, "Culinary Receipts," in which 188 methods of cooking the various kinds are enumerated. Besides these there are Notes on Mushrooms dedicated to Saints (half the information in which is false), an Index (carefully arranged so that nobody can by any exercise of ingenuity find the species he is in quest of), chapters on the Discrimination of Fungi, their Use, Anatomy, Classification, Chemistry and Toxicology, Cultivation, &c., &c., and finally, at the end of the work, sixty-four plates of all possible kinds of fungi, eatable and uneatable, only eight or ten of which have even the slightest connection with the subject matter of the book.

It is evident from this that there is much to commend, but also much to criticise in the result of Mr. Hay's endeavours. Perhaps his greatest fault is his deficient sense of the ludicrous, which suggests for him a Scotch descent. In regard to the plates, *e.g.*, which are the most objectionable of all the blunders, he is careful to make the publishers responsible for the stupidity of including in a work dealing with *eatable* fungi, a series of plates representing microscopic species, many of which are totally invisible to the naked eye. The publishers' apparent desire was to make the book look larger and more imposing at a cheap cost, and for this purpose they dragged in, regardless of their impertinence, all the old figures formerly used to illustrate Cooke's Handbook. But the author ought to have foreseen the ridicule which such a proceeding would call down upon him, and have made a stand against the spoiling of his work.

The want of a feeling for the ludicrous is still more plainly visible in the English names he invents for the heading of his descriptions. It might be well to have English names by which to designate the eatable and poisonous kinds; but certainly no one, outside a company of the insane, could use those which the author has invented without exciting Homeric laughter.

Picture to yourself the funeral procession on its way to the cemetery of Big St. George, the Arch-Bane, seated on Beelzebub's Cushion, at its head; the Golden Spindle-spike for the beadle, the Crocodile for chief mourner, the Guilty-sprout for the corpse, the Sickener as the medical man, the Black Bulgar as the "intelligent foreigner," the Longshank and the Spotty-leg Bolet as the mutes, the Chamæleon and the Yellow Reptile to draw the hearse, the Wrinkle-twig to form the plumes, and the Turn-over to dig the grave. With what conscience could you invite your friends to a dainty dish of Rat's-paws, or Red-nails, or Blood-stains, or Peg-tops, or Little Darkies, all of which are put forth as edible; the latter suggests cannibal propensities. The titles of some of the culinary receipts are just as laughable; it does not sound like a cook's duty "To prepare Parasols," or "To pickle Spindle-shanks," while when the author shows us how "To prepare Urchins," he surely trespasses upon the governess's domain. "Urchin Ragoût" has an uncanny sound; and most fungus-eaters, who, as becomes a naturalist, are usually somewhat bashful men, might shrink from being introduced to such sirens as the Grisette, the Ingénue, the Blusher, the Brazen-face, or the Sickener's Sister.

The total number of esculent species enumerated is 221; but some of these are such as few people would care to tackle. Yet I have myself eaten two of the most unlikely, *Polyporus squamosus* (young, of course), and *Lactarius turpis*, and though it must be confessed they are not nice enough to tempt a dying anchorite to eat, yet they form a respectable alternative to starvation. Many of the species mentioned are also rare; but still one can eat them when they are met with, and therefore it is as well to include them. The number of poisonous species is only fifty-three, so that the chances against one's being poisoned may be reckoned about four to one. Of course the vast mass of fungi are such as either offer nothing to eat or, if eaten, exert no active influence whether harmful or the reverse.

The enquirer who takes this book as his guide will find a great many of his fungophobic superstitions disappear before the author's treatment of his subject. It is not many evenings since, in the centre of Birmingham, two little parties of five and four sat down to a fungus supper, the courses of which consisted entirely of toad-stools, cooked according to the recipes there given. Those who partook of them are still alive, and anxious to repeat the experiment. If only Mr. Hay would strike out those false or redundant parts in which he travels beyond his knowledge, such as his random etymology and the note on p. 48, which is exactly sixteen years behind the times, and would confine his remarks to that which he has actually himself investigated, this book, rebaptised and reduced to about half its size, would then become an essential element in the library of every fungus-eater.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 288.)

"Stourbridge and its Vicinity," by William Scott, has been previously referred to in these pages. It was published in 1832. The introductory remarks to the Botanical Chapter will be found at p. 539; they are followed, at p. 540, by "a select descriptive Botanical Catalogue." Many of the species enumerated therein are stated by the author to have been "honoured by an insertion in the 'Midland Flora.'"

This Catalogue is at once one of the most interesting and one of the most provoking contributions to the history of Worcestershire Botany. It has preserved to us a record of the rarer Flora of Cradley Park, woodland in Scott's time, soon after stocked and converted into arable, and subsequently changed into collieries and brickworks. It records also other plants of the Stourbridge district, now extinct. On the other hand, it has many defects. Stourbridge is in the County of Worcester, very near the Stafford boundary. In many cases the exact localities are not given, and it is impossible to tell whether the plants named were found in Worcester or Stafford.

For instance, several rarities are recorded from "*Iverley*," a district on the high road from Stourbridge to Kidderminster, situated on both sides the county boundary, without any notice whether the plants were found in Worcester or Stafford. In other cases the specific names are omitted, or the names quoted in such a manner as to make it impossible to tell what plants were intended. Finally, there are so many obvious errors of identification as to throw more or less discredit on the entire list. Under these circumstances I have introduced a new sign (‡) to indicate plants which may not be misnamed, but which cannot be certainly claimed as Worcester records. I have given Scott credit for most of the common plants inserted without locality, omitting a few recorded by previous authors.

William Scott. "Stourbridge and its Vicinity." 1832. A select descriptive Botanical Catalogue, p. 540.

* **Ranunculus parviflorus.** Lanes near Hagley.

* **Nymphæa** (*Nuphar*) **lutea.** Blakedown; Broadwaters, near Kidderminster.

* **Fumaria** (*Corydalis*) **claviculata.** Dingle near Lye.

F. capreolata. Dingle near Lye.

* **Cardamine impatiens.** Double blossomed. Field near the Spout, Hagley. Noticed by Withering.

An error for C. pratensis. (See Withering, 4th Edition, p. 568.)

* **Turritis glabra.** Hagley; Wollaston; Bridgnorth Road.

Cochlearia Coronopus. (*Senebiera Coronopus. Poir.*) Heath Road side.

‡ **Viola Hottonia.** Marshes. *No locality.*

The plant probably intended is Hottonia palustris, L., not now known near Stourbridge. It is strange that the locality should not have been specified. It grew on Birmingham Heath in Withering's time. (See Stokes's Withering, p. 954.)

V. odorata. Blue, purple, white. Common.

‡ **V. parviflora** of Dr. Stokes, clandestina of Hortus Croomensis. Iverley Hill, summit of sandpit, Pedmore part of the Hill.

The identity of this plant is too uncertain to assign any modern name to it.

V. canina. (*V. sylvatica. Fries.*) Woods about Cradley, &c.

* **V. tricolor.** Cornfields.

This I take to be the form V. arvensis, Murr. The type has previously been recorded.

* **Drosera rotundifolia.** Pedmore Common; banks of Harborough Pool.

† **Dianthus cæsius.** Blackstone Rocks near Bewdley.

An error for Dianthus deltoides.

* **Saponaria** (*officinalis*). Banks of Stour near Lye Mill.

‡ **Silene conica.** One field, Iverley. Now extinct.

Query in which county and whether really this species?

* **Hypericum Androsæmum.** Lutley Holloway.

* **H. humifusum.** Sandy fields.

* **Radiola millegrana.** (*R. linoides. Gm.*) Banks of Harborough Pools; Pedmore Common.

* **Linum catharticum.**

* **Geranium phæum.** Cradley Park.

* **G. lucidum.** Halesowen Hill.

G. Robertianum, album. Lutley.

* **Erodium moschatum.** Sandy fields.

* **Euonymus** (*europæus.*) Hedges near to the Lye, and Hagley.

* **Ulex europæus.** West of Iverley Hill.

* **U. nanus.** East of Iverley Hill, and various commons.

Doubtless U. Gallii, Planch.

‡ **Genista spinosa.** Whittington Common, *Stafford.* Plentiful, but observed nowhere else.

This is G. anglica. (See Purton, 333.)

G. tinctoria. Coalpit banks in various directions. (*Some probably in Worcester.*)

* **Anthyllis Vulneraria.** Banks of Dudley Canal between Haywood and Lappal only.

* **Ononis alba.** Haseler, near Evesham. Very rare. Purple, common.

This may be accepted as a record for Ononis arvensis.

* **Trifolium arvense.** Sandy grounds.

* **T. fragiferum.** Hagley. Rare.

Not seen at Hagley in recent years.

* **Comarum palustre.** Morass, near Pedmore Common.

⁎ **Rubus Idæus.** Woods and marshes.

* **Rosa spinosissima.** Blakedown Holloway.

* **Peplis Portula.** Pedmore Common.

* **Circæa lutetiana.** Foxcote, Oldenhall, and many other places.

* **Sedum Telephium.** Lickey Hills.

* **Cotyledon Umbilicus.** Near Clent Church.

Not now known in this locality.

* **Saxifraga granulata.** Hagley, Churchill.

* **Chrysosplenium oppositifolium.** Cradley Park, Harborough, Lutley, various morasses, banks of Stour and other streams.

* **Hydrocotyle vulgaris.** Harborough and Pedmore Common.

Sanicula europæa. Cradley and other woods.

Cornus (*sanguinea*). Hedges near the Lye, Love Lane, Hanbury Hill.

* **Adoxa Moschatellina.** Foxcote, Holloways at Oldenhall, and between Broughton and Drayton.

Sambucus Ebulus. Overend, Cradley.

Viburnum Opulus. Cradley Park.

* **Galium saxatile.** Heaths, &c.

G. Aparine. Marshes.

G. Witheringii. *No. locality.*

Var. of G. palustre.

Sherardia arvensis. Corn and grass fields.

* **Dipsacus pilosus.** Banks of Stour, near Stourbridge, on the road to Halesowen; Lye Mill.

Serratula tinctoria. Banks of rivers and canals.

Centaurea Scabiosa, greater Knapweed. Cornfields.

C. nigra, lesser. Cornfields.

† **C. Jacea,** radiated. Cradley Park.

An error. Probably C. nigra, with radiant heads.

‡ **Artemisia Absinthium.** *No locality.*

Bidens cernua. Banks of streams.

* **Conyza squarrosa.** Vicinity of Hagley.

* **Solidago Virg-aurea.** Coppices, Cradley, and Stamber Mill.

Campanula glomerata. Dudley Castle Hill.

* **C. latifolia.** Lutley Holloway.

* **C. patula.** Cradley Park, vicinity of Broughton, Churchill, &c.

* **Vaccinium Myrtillus.** Cradley Park, Pedmore and other Commons, Bilberry Hills, Lickey.

* **V. Oxycoccus.** Pedmore Common.

* **Erica** (*Calluna*) **vulgaris,** alba.

E. cinerea, alba.

* **E. tetralix,** alba.

All very rare; purple, common.

† **E. ciliaria.** Once growing in a morass near Round Hill, Iverley. Stafford

I suppose intended for E. ciliaris; must be an error.

Pyrola media. Cradley Park. Very rare. The only plant, transplanted, cultivated, and soon lost, 1817.

* **Vinca major.** Broughton near the bridge, [Iverley Hill, and Holloway leading to Churchill.] Stafford

* **Chlora perfoliata.** Fields near Wychbury Hill, Cradley Park.

* **Menyanthes trifoliata.** Blakedown and Harborough.

* **Solanum nigrum.** Hagley Lanes; Wolverley.

* **Atropa Belladonna.** Dudley Castle Hill.

The "Bell's Mill" locality communicated to Purton is not recorded.

* **Hyoscyamus niger.** Hagley and Broom Lanes. Become very scarce.

* **Verbascum Thapsus.** Commons.

* **V. Blattaria.** Commons.

V. Lychnitis. Hagley.

This is the first record of V. Lychnitis as a Worcester plant. It does not now grow at Hagley.

* **V. nigrum.** Hagley; Broom.

* **V. virgatum.** Iverley. Rare.

* **Limosella aquatica.** Pools near the Heath.

* **Melampyrum pratense.** Cradley Woods.

* **Verbena officinalis.** Drayton in Chaddesley.

Thymus (*Calamintha*) **Acinos.** Churchill Field corner.

* **Scutellaria** (*galericulata*). Banks of streams and canals.

Melittis grandiflora (*var. of M. Melissophyllum*). Woods and fields near Halesowen.

***Marrubium vulgare.** Iverley. Baldwin's Green near Lye Waste.

* **Leonurus Cardiaca.** Iverley Hills and adjoining fields.

Ajuga reptans. White. Wollaston Rocks.

Query in which county?

* **Symphytum officinale.** Banks of streams; morasses.

* **Cynoglossum officinale.** } Brettel Lane; canal banks; roads near
† * **C. sylvaticum.** } Hagley, &c.

Cynoglossum sylvaticum must, I think, be an error.

* **Lysimachia nemorum.** Woods. Cradley.

L. Nummularia. Cradley Park, Hodge Hill, Wychbury Hill.

Anagallis arvensis (*no locality*). "In addition to the scarlet a blue variety is found on Bredon Hill."

This is the first record of the common form. The blue var. is noticed by Nash.

* **Plantago media.** Pedmore Rocks.

* **P. Coronopus.** Commons.

† **P. maritima.** "Flourishes at Stourbridge." (*See foot note in Scott, p. 553.*)

Surely this must be an error.

† **Rumex aquaticus.** Banks of Stour, &c.

Probably an error for R. Hydrolapathum.

Polygonum Persicaria.

* **P. Hydropiper.**

P. Fagopyrum.

* **Daphne Laureola.** Woods. Witley, &c.

Parietaria *(officinalis, L.)* Chaddesley.

Humulus *(Lupulus)*. Casually occurring in hedges.

‡ **Populus communis.** Banks of Stour.

What can this mean?

P. alba. Banks of Stour.

P. tremula. Harborough.

P. nigra. Near the Hayes on Banks of Stour.

Typha latifolia. Harborough, various pools.

Sparganium ramosum. Very common in morasses.

S. simplex. Very common in morasses.

* **Sagittaria sagittifolia.** Banks of Dudley Canal near Lappal Tunnel only.

Alisma Plantago. Ponds.

* ‡ **Butomus umbellatus.** Different levels of canal near Moor Lane, in the water. Query county?

Orchis maculata. Woods and meadows.

* **Orchis**, handed. Cradley Park. Very rare.

This must be Gymnadenia conopsea. (See Purton, p. 422.)

‡ **Ophrys.** Wychbury Wood, Cradley Park and fields.

Query what species?

* **Serapias grandiflora.** Woods near Lea Castle, Wolverley.

Cephalanthera grandiflora, Bab.

‡ * **Satyrium viride.** No locality.

Habenaria viridis. R. Br.

† **Satyrium albidum.** Cradley Park, Wychbury Wood, Hodge Hill, Blakeshall.

Gymnadenia albida Rich. Certainly an error; perhaps Habenaria bifolia was mistaken for it.

* **Narcissus Pseudo-narcissus.** Overend, Cradley.

×**N. biflorus.** Glasshampton, Worc.

×**Tamus communis.** Hedges.

* **Paris quadrifolia.** Wychbury Wood, Cradley Park.

Juncus (*Luzula*) **campestris.** Meadows.

J. bufonius.

J. effusus.

J. conglomeratus.

* **J. squarrosus.**

* **J. uliginosus.** Morasses, banks of streams and other humid sites.

(*J. supinus, Mœnch.*)

(*To be continued.*) p 40

Mr. Herbert Spencer.—The numerous friends and admirers of the distinguished philosopher will be interested to hear that he has recently left Brighton, where he has been living for nearly two years, and taken apartments at Bournemouth, and that the change has already been of considerable benefit to his health.

Local Birds.—It will interest students of ornithology to know that the following birds were recently shot within a few miles of Birmingham, during one half-day's collecting:—Temminck's stint, *Tringa Temminckii*; little stint, *T. minuta*; dunlin, *T. alpina*; curlew sandpiper, *T. striola*; ringed plover, *Charadrius hiaticula*; red shank, *Totanus calidris*; common tern, *Sterna fluviatilis*; black tern, *S. fissipes*.—J. Betteridge.

Reviews.

A Manual of the British Discomycetes, with Illustrations. W. Phillips, F.L.S.—London: Kegan Paul, Trench and Co.

This, the sixty-first volume of the International Scientific Series, is another instalment of the work which is being slowly done towards placing the British mycologist in the same position with regard to the present state of that science, which the publication of the "Handbook of British Fungi" enabled him to assume sixteen years ago. The "Hymenomycetes Britannici," already noticed in these pages, worthily led the way, and of the present volume it would be sufficient praise to say that it does the same with respect to the group of which it treats, that was done for the higher fungi in the Rev. John Stevenson's two charming volumes. But more, far more than this, can be said. The "Hymenomycetes" was, in part, confessedly a compilation, founded on the last work of the immortal Fries—a clever and useful compilation, it is true, irradiated throughout by the touches of one who knew his subject. But here we are in the presence of a

master hand, one which is personally familiar with all the details of which it treats, and the consequence is a fulness of knowledge, and an all-pervading clearness which are the more enchanting, the more bewildering the chaos which they have put to flight. The typographical arrangement leaves little to be desired. I have several times taken occasion to urge the importance of this consideration; a little more space devoted to the summaries of genera and species, a little more recourse to the various kinds of type, make an enormous difference in the comfort and convenience of those who use the book. Works published on the Continent are often sadly wanting in this respect; even when the subdivisions have been made, the headings are so carefully hidden away in the mass of type, that it takes almost as long to discover them as it would to make the subdivisions oneself. One thing is, perhaps, to be regretted: the lists of localities given are in some cases so meagre as to be misleading, since they convey the impression that some of the species are much less widely distributed than they really are. But no lists of localities, however complete, could of course remain so beyond the moment of publication. The recent discovery of the almost unique *Boudiera areolata* by Mr. J. W. Oliver, in the immediate neighbourhood of this town, is but a specimen of what is always going on. It now remains but to add that the seventy-nine figures given at the end are marvels of minute and accurate detail, to show that this is a book of which Mr. Phillips and his publishers may well be proud. W. B. G.

The Geology of England and Wales; with Notes on the Physical Features of the Country. By Horace B. Woodward, F.G.S., of the Geological Survey. Second edition, 8vo., 670 pp., 101 woodcuts, and coloured map. London: G. Philip and Son, 32, Fleet Street; price 18s.

This work can only be described as an encyclopædia of English geology. And yet it is far more than an encyclopædia, for the enormous collection of facts is marshalled in so orderly and well-arranged a manner that it reveals the geological history of our country in a far more truthful way than any "history of kings and peoples" that has ever been written.

The frontispiece is a capital autotype reproduction of a photograph of the well-known red-chalk cliff of Hunstanton; and at the other end of the book there is an admirable index, extending over no fewer than 45 pages. Another feature of the book is the excellent "Synopsis of the Animal Kingdom, with especial reference to the Fossil Forms," drawn up by Mr. E. T. Newton, the well-known palæontologist.

In the body of the book, by the use of two sizes of type, an enormous number of facts are included. Each geological formation is discussed separately, its range across the country minutely pointed out, its fossils, rocks, and ores described; while in foot-notes references are given to the original authorities cited.

The first edition of Mr. Woodward's book—published ten years ago—obtained a wide and well-merited circulation; but this second

edition is practically a new book. It must have cost the author an immense amount of labour, but he may find comfort in the fact that his work will—must—find a place in every library, and upon the shelves of every geologist. W. J. H.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, November 1st. Prof. W. Hillhouse, M.A., in the chair; the subject being "Photo-micrography," with practical illustrations, by Mr. John Edmonds, who, after mentioning that too much had been made of optical difficulties arising from the non-coincidence of the visual and actinic foci of micro-objectives, and also of the apparatus required, and explaining the necessity for and method of obtaining adequate and equal illumination of the object, proceeded to state that his principal purpose was to show how photo-micrographs could be taken at night with the minimum of apparatus, by projecting the image of the object upon a sensitive plate, having first focussed it either upon an opaque screen formed of a plate of opal glass having a dead surface produced by grinding with fine emery powder, or upon a transparent glass plate, subject to the same process—according to the nature of the object and the amount of amplification required—the only other apparatus being an Argand petroleum lamp, with a metal chimney, emitting light only from a circular opening in front; a bull's eye condenser; the stand of a microscope (the body and eye-piece having been removed); and the objective. The room having been darkened, the lecturer projected upon the ground glass an image of a mounted *Aphrophora spumaria* (cuckoo spit), he then removed the ground screen, and substituted the sensitive gelatine dry plate of the kind known as "Ilford ordinary," quarter-plate size, and after an exposure of twenty seconds, developed, fixed, and washed the negative, and placing it in the lantern, exhibited an enlarged picture of the insect to the audience. The lecturer then showed several photographs of insects, entomostraca, vegetable sections, polycistina, &c., taken in the manner described, with objectives ranging from four inches to one-sixth inch focus. Messrs. T. H. Waller and C. Pumphrey took part in the discussion which followed, and Mr. F. J. Cullis spoke in commendation of the process and the manner of its exposition.—GENERAL MEETING, November 29th. Prof. W. Hillhouse, M.A., exhibited mustard seeds, germinated on a dry surface but in moist air, showing finely developed roots in the air, with an abundant root-hair system. A potato, which had germinated without light but in two stages, producing, in the first year, slender elongated tubers, resembling in form the pseudo-bulbs of many orchids, these latter, in the following season, giving rise to the long slender stems familiar to us in "sprouting" potatoes. Also, another potato, germinated in absolute darkness, which had given rise to a network of slender stems, bearing minute rounded tubers at the ends of short branchlets. Mr. Chas. Pumphrey exhibited an ironstone nodule with a clay core, from the drift at King's Norton, which bore a striking resemblance to an animal's tusk, six inches long.—MICROSCOPICAL SECTION, December 6th. Prof. W. Hillhouse, M.A., exhibited specimens of *Eucalyptus globulus*, showing the different forms of the leaves in different stages of its growth. He also explained the benefits arising from its antiseptic properties. Mr. J. E. Bagnall, A.L.S., exhibited,

for Mr. F. Enock, *Cyathus vernicosus*, the "bird's-nest" fungus, from near London. Mr. W. B. Grove, B.A., exhibited *Phycomyces nitens* (*Mucor Phycomyces*), growing on bread-and-butter; this mucor is the finest species of the group. Mr. W. P. Marshall, M.I.C.E., exhibited his new $\frac{1}{25}$ inch objective, and showed some interesting diatom tests, &c.—BIOLOGICAL SECTION, December 13th. Mr. J. Levick in the chair. A fine specimen was exhibited by Mr. W. B. Grove of *Mucor phycomyces*, a giant mould, growing, with stems four inches high, and said to grow to a height of nearly a foot. Mr. W. R. Hughes read a paper upon *Hyalonema lusitanicum*, the glass-rope sponge, illustrated by a number of diagrams and of very interesting specimens under microscopes, including *Hyalonema lusitanicum*, *H. Sieboldii*, *Grantia nivea*, and *Euplectella aspergillum*.—SOCIOLOGICAL SECTION. At a supplementary Meeting on Thursday, December 1st, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Miss Dalton on Mr. Herbert Spencer's essay on "The Philosophy of Style." At a second supplementary Meeting on Thursday, December 15th, a paper was read by Mr. W. K. Parkes, on the first portion of Mr. Spencer's essay on "The Genesis of Science." On Saturday, December 17th, the tenth excursion of the Section was made to "Dr. Priestley's Country." The party drove to the principal places in Birmingham connected with the career of this celebrated father of modern chemistry; they afterwards took tea in the Society's Room, at Mason College, where a collection of Priestley books, pamphlets, engravings, and autograph letters was exhibited, and an address on the career of Dr. Priestley was delivered by the Rev. Dr. Crosskey.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 14th. Mr. H. Hawkes exhibited *Diderma globosum*, on holly leaf, a fungus, at one time supposed to be a low form of animal life; also a form of slide suitable for soirées, on which groups of similar objects can be mounted. The slide was a disc with a number of objects mounted near the outer edge. When the slide was revolved by the finger, the various objects appeared in succession. —November 21st. A paper was read by Mr. Delicate on "Trees." The writer dealt with the subject under three heads: their structure, products, and portraiture, and concluded by drawing a parallel between trees and animals. The paper was illustrated by a large number of photographs of trees, foliage, and fruit, exhibited by lime light, by Mr. O. Hutchinson.—November 28th. Mr. W. H. Bath exhibited pupæ and coccoons of British lepidoptera, including specimens of swallow-tail butterfly, currant clearwing, puss moth, death's head hawk moth, etc.; Mr. Bennet, a number of fossils from a gravel pit at Harrington.—December 5th. A Conchological night. Mr. J. Madison showed a large collection of specimens of *Limnæa stagnalis*, British, foreign, and fossil, and a number of specimens taken from one pond at intervals during the last thirteen years, showing marked variations; also specimens of *Helix pomatia*, just hatched, and of one and two years' growth.—December 12th. Mr. P. T. Deakin exhibited the tongue bones of woodpecker, *Picus minor*; Mr. J. Madison, an abnormal growth in the shell of *Planorbis corneus*, the outer whorl covering the next whorl; Mr. Corbet, specimens of *Calamites cannæformis*, *C. Luckowii*, and *C. approximata*, from Bradley. Under the microscopes Mr. Hawkes showed a circular slide of twelve wings of lepidoptera; Mr. J. Collins, spiral tissue in yew, and Mr. T. H. Waller, a section of a pebble of Tourmaline schist from King's Heath, showing two faults in the space of an inch.

NOTES ON THE WARWICKSHIRE STOUR VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

My interest in this district has been greater than in any other Warwickshire district, and this interest was first excited by my much respected friend, the late Rev. W. W. Newbould. Previous to his work nothing appears to have been done in this district, and, so far as I can find out, only one record exists, that of *Carduus acaulis*, Long Compton, given in Perry's List of Plants, contributed to the abridged edition of "Dugdale's Warwickshire," and published in 1817.

For two seasons, 1880-81, Mr. Newbould worked with evident diligence that portion of the Stour Valley adjacent to Honington, where he was residing temporarily, and officiating as vicar-in-charge of Honington Church. His researches were extended to all the district within a short radius of Honington, including Halford, Whatcote, Burmington, Ilmington, an occasional visit to Brailes, all in Warwickshire; and the neighbouring Worcestershire portions of the district, Shipston-on-Stour, Tredington, Willington, and Blackwell. All his notes and observations were carefully recorded in a manuscript volume, and the commonest weed was as carefully recorded as the more rare plant, with frequent interesting notes. In this same volume were also botanical notes on Warwickshire as a whole, culled from various printed sources, from Ray downwards, and from the various Herbaria existing at Kew, Kensington, and Cambridge. This volume, which is an epitome of industrious research, was very kindly placed in my hands by its author, and from this I gathered all my first notes from the Warwickshire Stour Valley, and much help for other portions of the county.

August, the 28th, 1880, by invitation from Mr. Newbould, I paid a visit to Honington. Mr. Newbould met me at Stratford-on-Avon railway station, and by the kind permission of F. Townsend, Esq., one of his carriages conveyed us the pleasant drive of ten miles to Honington. It was the most enjoyable ride I have ever taken, the day being fine, and my companion so truly congenial, so full of enthusiasm, with such a vast fund of anecdote or quotation from this or that famous

botanist past and present. Now and again the roadside banks became too attractive to allow us to pass them by, and then we walked and dallied and compared notes; ultimately we reached Honington, where, with thoughtful kindness, I found a second breakfast awaiting me. After that we had a good turn through the woods and pastures about Honington Hall for about four hours, and then returned through the pretty Worcestershire village of Tredington to dinner—and all the time we seemed in a sort of charmed land. Everything about me appeared to have fresh interest, for upon even the more common plants my companion had something to say, or something to tell me which Mr. Borrer, or Dr. Boswell, or Mr. Baker, or some other notable botanist had said; so that the time literally fled. But we were not idle talkers merely, for though the season was far advanced, and the ground covered of small extent, my companion had so well explored the district that I found by the entries in my note book we had observed in fruit or flower about 234 species. Part of our conversation was on the Flora of Warwickshire and the form it should take, and it was owing to this conversation that I decided upon rewriting the whole matter, and taking the water partings of the river basins as the basis of my districts, these being, in Mr. Newbould's estimation, the more natural botanical districts.

Mr. Newbould's work in this district was, as I have said, the first of which I had any record; altogether he recorded about 420 flowering plants and ferns. Included in this were some MS. notes (which he had copied from an old Flora) made by the Rev. James Gorle, vicar of Whatcote, and were most of them from Whatcote, Idlicote, or Halford.

These notes of Mr. Newbould's have also been supplemented by others kindly sent to me by F. Townsend, Esq. After Mr. Newbould's death, feeling a desire to finish as far as circumstances would allow a work so ably begun, I gave a portion of my leisure time of 1886-7 to this district, and, although my present record exceeds my own expectations, I am convinced that much still remains to be done. The district is very difficult of access, the nearest railway station at the southern extremity being Moreton-in-Marsh, which is two miles from the Warwickshire border, has an inconvenient service of trains, and is a journey of from three to four hours' duration. The stations on the northern border are Ettington and Kineton, both of them being very awkward as regards the service of trains. No line of railway or canal penetrates any portion of the district, a tramway running from Stratford to Moreton-in-Marsh is used for goods only, and seems little

used. So that to work this district long walks have to be taken, and thus much time is lost in getting from one part of the district to another.

Position of the District and Boundaries.

The Stour Valley lies south-west of the Edge Hills and north of Bright Hill, a narrow tongue of it running north of Ilmington to a few miles S.W. of Stratford-on-Avon. Its geographical position is 51° 58′ 20″ to 52° 9′ 50″ north latitude, and 1° 44′ 5″ to 1° 50′ 0″ west longitude. It is bounded on the south by the high road running over Bright Hill to Chipping Campden—this includes some of the outlying portions of Worcester and Gloucestershires; on the west by the elevated land about Ilmington, Preston-on-Stour, Atherstone-on-Stour, and a line from the latter village to the Avon, just below Milecote; on the north partly by the Shipston Road from Stratford-on-Avon, to near Upthorpe Bridge, thence by the lane to Upper Eatington, and from this point by the high road from Eatington to the high road to Lower Tysoe; on the east by Tysoe Hill and the highway from Over Tysoe, over Traitors' Ford to Bright Hill. The total length of the district is about 17½ miles; its breadth in the widest part about 10½ miles. This, however, includes a portion of Worcester and Gloucestershires, which has not been included in my notes. The acreage of the Warwickshire portion of the district is some 46,000 acres.

Elevations.

The Stour Valley is surrounded on all sides by hills and elevated land, but the elevations are in no instance sufficiently great to influence the flora. Taking our stand upon the southern boundary of the district, Bright Hill, we may from this point get a more general view of the physical features of the district than possibly from any other point. Here, at the highest point, we get an elevation of 727 feet above sea level. Close to hand are the famous Rollright Stones, which are probably Druidical remains, but of which legend informs us that long, long ago, a Danish prince, consulting an oracle before invading this country, received the assurance—

> "When Long Compton you shall see
> You shall King of England be."

The landing was effected, and the invading force had almost reached the goal of their desires, when the prince, stepping forward to catch a glimpse of Long Compton, was, by a

patriotic British fairy, turned into stone, with all his attendant host. The block still stands near the highway, and near to this other groups of stones which are supposed to represent his knights.

Turning our backs on these remains, we look over a pretty fertile woodland valley. Immediately below us, about two miles distant, lies Long Compton, or, as it is sometimes called, Compton-in-the-Hole; the elevation here having fallen to 340 feet, but all around the country is elevated. In the north-east is the high land above Lower Tysoe, its highest point being 704 feet. In continuation of this is the elevated ridge forming the Oxfordshire boundary, over which is the highway to Chipping Norton, the highest elevation on this highway being 705 feet. Looking north, the view is bounded by the high land about Compton Wynyates, the highest point being 611 feet, and a little S.W. of this looms Brailes Hill, a noticeable object from most portions of the district; here the elevation is about 750 feet. Lying between this and the western boundary is the flat valley in which Burmington, Shipston-on-Stour, and Honington lie. Looking to the left, over the woodlands and heath lands of Barton-on-the-Heath and Wolford Wood, we see in the distance the western boundary of the valley; Ebrington Hill, and here near Ilmington Downs, is the highest point in the county, 855 feet; and Knowlands Hill, which is part of the same plateau, has an elevation reaching about 800 feet at its highest point. The northern boundary of the Stour Valley, the main road from Upper Eatington to Banbury, is a slightly elevated ridge, the one side draining into the River Dene, the other into the Stour. The elevations on this road range from 331 feet to 412 feet. The north-west portion of this district is a flat, narrow valley, bounded by the Shipston Road. This, at Halford, has an elevation of about 200 feet, Whitchurch 133 feet, and at Milecote, which is close to the confluence of Stour and Avon, 120 feet. Of the geology of this district I am unable to speak with confidence. The prevailing soils appear to be those of the Lower Lias clays and limestone. The high lands forming the eastern border, which are a southern extension of the Edge Hill, are said to be formed by the marlstone of this series. At Brailes the Upper Lias clay is found. This, it is thought, once capped the marlstone there, and has since been denuded, leaving only the harder included limestone, (Fish-bed) portions of which are scattered in the fields below the hill. In some portions of the district light sandy soils prevail.

(To be continued.)

ON SOME AID RENDERED BY PHOTOGRAPHY TO GEOLOGY.

BY W. JEROME HARRISON, F.G.S.

Photography has rendered aid, in turn, to nearly all of the sciences, but I wish to note here just three cases which have lately come under my notice where it has been specially serviceable to geology.

In 1858 the question of the antiquity of man was brought prominently before the public by the discovery of flint instruments, clearly fashioned by human hands, in certain gravel-beds at St. Acheul, a suburb of the town of Amiens, in the north of France. These gravel-beds were deposited at some former period by the River Somme, but as the river now runs at a level ninety feet below these old gravels, it was admitted by all that the gravels were of very great antiquity. Besides the flint tools, these gravels contained many bones of animals, some of extinct species, such as the mammoth, cave-bear, &c. The French archæologists, M. Boucher de Perthes and Dr. Rigollot, had already collected hundreds of these flint implements from the gravel-beds when the question of their age was brought before the geological world. The leading men of science, both of England and France, were not at all prepared to accept the evidence afforded by the flint implements without strict investigation, and some of them, indeed, pooh-poohed the thing altogether. They insisted that the flints might have been made by the workmen engaged in the gravel-pits for the sake of the recompense they obtained when they found one (and certainly it was true that all the specimens hitherto discovered had been purchased from the men, or picked up on the floor of the pits). Others, more generous, believed in the authenticity of the specimens, but suggested they had been dropped down to the depth in the gravel-beds at which they were found, either by a settling of the strata, or through some crevice in the beds.

It was to settle this most interesting question that Mr. Prestwich (till lately Professor of Geology at Oxford) visited Amiens in the autumn of 1858. He superintended fresh excavations by the workmen, and shortly had the pleasure of uncovering with his own hands the end of a fine, well-shaped flint hatchet, lying at a depth of seventeen feet from the surface. This was convincing enough for Mr. Prestwich, but he wanted

to equally convince others; so, fetching a photographer, several capital negatives were secured, showing the tool still embedded in the strata, and showing also, what was equally important, that there were no signs of any vertical rents, breaks, or any disturbances whatever in the overlying beds of sand and loam, which, indeed, contained many fresh water shells, and had, evidently, never been disturbed since they were deposited, long ages ago, by the River Somme.

The photographs so secured were presented to the Royal Society with the talented geologist's report, and carried conviction to many minds, so that many other inquirers visited St. Acheul, including Mr. James Wyatt, who, on his return to England, set to work and succeeded in finding precisely similar specimens in the gravels of the Ouse at Bedford.

The enormous period of time for which man has been an inhabitant of this earth is now clearly recognised, and no small share in the obtaining of this speedy recognition is due to Mr. Prestwich's photographs.

The second instance to which I refer was connected with the discovery of Dr. Rivière, of a skeleton of one of the early men by whom the stone tools were fashioned and used, and who were undoubtedly ignorant of the use of metals. It is singular that the bones of these early races of mankind should be so scarce; their weapons we find in plenty, but of their bones hardly a trace. It was, therefore, a grand event when Dr. Rivière came across a complete skeleton of a palæolithic (or early stone-age) man in a cave near Mentone, in the south of France, in March, 1872. He had been excavating in a shallow hollow in the rocks, when he found the bones of a human foot, and this encouraged him to excavate the cavern, which proved to be of great extent; forty-five feet in length—running north to south, opening towards the south—and of great height. The skeleton lay at a depth of seventeen feet, and was twenty-four feet from the entrance; surrounding it and above it were fifty rude flint flakes, or scrapers, with many bones of animals, some of extinct species, but no trace of metal, pottery, or polished stone. The bones were those of a man five feet nine inches in height; the skull was of a red colour, and was covered with a chaplet of perforated shells and teeth of stags. There the skeleton lay, a grand sight for the geologist, or the student of pre-historic man. But how to preserve a record of its exact disposition and appearance, a thing especially important, as the manner in which the body was laid out for interment—whether on the back or side, outstretched, or with the knees drawn up—is one of the characteristics by which its probable antiquity may be determined.

Fortunately the sun shone right down the cave, and it was an easy matter to secure an excellent photograph of the bones before they were disturbed.

Very many cases have occurred of the uncovering of skeletons and other objects in burial grounds, and even of the illustrious dead in our cathedrals, &c., where all trace of the objects faded away in a few minutes after exposure to the air; the bones crumbling to dust with a touch. If the forethought had been taken to have a camera at hand, many other pictures might have been secured of great value to the scientist and the historian.

Lastly, I am sure no one will acknowledge more freely the aid which photography can render to geology than that excellent geologist, Dr. Johnstone-Lavis, F.G.S., who is employing the camera freely as an aid to his studies of the volcanic phenomena of Vesuvius; studies which have now extended over some considerable time, and which are encouraged and aided by the British Association.

All volcanic regions are subject to rapid changes of form and level, and a record of such change is of the highest importance in the study of vulcanology. The cone of Vesuvius, we know, has undergone most wonderful changes in the past. The hill we call Monte Somma, and the lower elevation of La Pedimentina, are relics of an old cone of far greater dimensions than the existing one; and a series of photographs, showing the condition of the volcano at regular and frequent intervals since that mighty eruption in A. D. 79, which overwhelmed Pompeii, would indeed be interesting and important. But if it is not possible to now recall the past, we can at least provide for the future, and this is just what Dr. Lavis is doing, by securing almost daily photographs of the crater, plain, and the interior and exterior of the cone of eruption. These change rapidly, sometimes within an hour or two, and the changes afford an important clue to the nature and action of the important, but as yet somewhat mysterious, forces which are at work beneath Southern Italy. Some of Dr. Lavis's photographs were exhibited during the meeting of the British Association at Birmingham in 1886, and will be reproduced in a journal which is published by the Naples section of the Italian Alpine Club.

In writing these few lines I have merely jotted down the first three instances which occurred to me of the aid which photography has been able to render to one science only, viz., geology. Did time and space permit, books might be written describing the assistance which this young art—not yet half a century old—has rendered in all branches of science and art.

And yet nine out of ten people still think of photography as simply a mechanical method of taking portraits. Let it be the task of photographers—and more especially of amateurs—to show of what infinite applications, and those of the highest and most accurate nature, photography is capable.

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S.

(Continued from page 11.)

I germinated, alike in light and darkness, the following seeds, viz.:—*Cynoglossum officinale*, *Vicia Faba*, *Ricinus communis*, *Phaseolus multiflorus*, and *Helianthus annuus*, growing each, in the experiments in darkness, up to exhaustion point.

Cynoglossum vulgare in which, according to Schell, the tannin produced during germination is subsequently used up, I fully germinated. The testa of this oily seed contains no tannin; in the cotyledons, however, a certain amount is present. In the seeds germinated in light, a continuous, but variable, increase in the amount of tannin present is manifest. In those grown in darkness, the earlier stages of germination are likewise accompanied by an increase in the amount of tannin produced, but as the reserve food stores become exhausted, and no new food materials result from chlorophyll action, the contents of the cells become progressively more watery, and an apparent diminution of tannin contents takes place, but it is not at all clear whether this results from greater dilution or actual diminution. A comparison of the etiolated with the non-etiolated material gives distinctly the presence of larger quantities of tannin in the latter, but this by no means necessarily implies usage of the tannin in the former, owing to exhaustion of the food supplies, but may be due to no secondary food formation, with its accompanying tannin formation, taking place.

Vicia Faba is specially interesting owing to the tendency for tannin, here highly coloured brown, to accumulate in vertical rows of cells in the neighbourhood of the vascular bundles, especially in the primary root. In the lateral roots this is much less markedly the case. In the testa there is abundant tannin, and this in the process of germination undoubtedly largely diminishes, but here also an element of doubt comes in, as to whether the diminution is not due to

escape by diffusion in the partial decay of the testa. Judging from the nature and origin of the testa, evidence derived from changes in its cell-contents is as unreliable as can well be conceived. In this seed tannin is specially recognisable in the neighbourhood of the seats of growth, and with cell-enlargement apparently diminishes in quantity, but for reasons which I rather associate with dilution than with consumption. Here also plantlets grown in darkness show ultimately less tannin contents than those grown in light, but for reasons which I believe mainly, if not altogether, due to there being no secondary production of tannin.

The other seeds germinated give results which in all practical points agree with these.

Acorns and horse-chestnuts, self-sown and germinating in the open ground, although showing on July 18th incomplete exhaustion, gave no evidence differing from the above. In the seeds the quantity of tannin had in no way decreased, but rather, and in the case of the horse-chestnut notably so, increased. The whole seedling stem of *Quercus* showed very abundant tannin; the apparent consumption near the growing point referred to by Sachs (*l. c.*) might equally be due to dilution through cell-enlargement, accompanied by the removal of the free glucose.

It must, however, be further pointed out that in germinating seeds to exhaustion, in proportion as exhaustion approximates iron salts become increasingly more and more untrustworthy, an observation which completely tallies with the remarks made above upon the increased dilution of the tannin contents at the same period. It may be that this affords a clue to the differing results obtained by different investigators where iron salts have been used. Nor must the peculiarities of potassium bichromate in this respect be lost sight of; so that from all points of approach much is left to the judgment of the investigator. It may be further noted that the seeds in the germination of which in darkness tannin shows the most marked presence and the greatest appearance of diminution are those which, like *Ricinus communis* and *Cynoglossum officinale* are more or less rich in oil; this lends some support to the conception that tannin may be of some utility in such cases through its ready oxidisability

Some investigations into the transfer to the stem of the cell-contents of the leaf prior to its autumnal fall in deciduous trees* show that in all cases where tannin is present in the living

* "Preliminary Notes on the Autumnal Fall of Leaves."—Report of the British Association, 1886, p. 700—1.

leaf it is present in apparently the same quantity and with the same distribution in the fallen leaf, *e.g.*, in *Æsculus Hippocastanum*, *Salisburia adiantifolia*, *Catalpa bignonioides*. On the other hand, these investigations have led me to look upon the complete emptying of the leaf of its starch cell-contents as the surest sign of approaching fall. A few evergreen shrubs which I have examined from the same point of view show the same more or less complete removal of starch from the leaf in winter, while, on the other hand, tannin may be present in abundance, *e.g.*, *Ilex aquifolium*, *Rhododendron ponticum*. I have examined about forty species of deciduous or evergreen plants, finding no essential divergence from these results.

I have made no observations upon the relations of tannin, with the ripening of fruits. Mack* and Haas† state that in the ripening of the grape the quantity of tannin diminishes. Buignet‡ had previously suggested this is various fruits. Observations with fruits must, however, be made with some caution. Artificial selection has tended naturally to the production, for edible purposes, of fruits in which the natural tannin contents are either diminished, or localised in certain special parts, such as skin, testa, &c., and this localisation may take place during the processes of ripening. In the second place, the same artificial selection may have established in cultivated fruits a tendency to transfer their tannin to the stem in ripening. Many fruits, however, ripen normally when severed from the parent plant, and if in such dissociated ripening analysis showed a reduction in the quantity of tannin contents, substantive evidence would undoubtedly be provided.

In the absence of any reliable method of separating tannin from free glucose, and further of separating tannin from the glucose with which it is loosely combined, micro-chemical investigations are prosecuted under considerable difficulties. No one would seriously dispute that in the processes of growth the free glucose could be separated out; nor is it in any degree improbable that in exhaustion experiments the "tannin" may be more completely reduced to the "tannic acid" state §; the point actually at issue is the decomposition of tannin in such way that tannic acid itself disappears by

* *Mack*, Bot. Jahresb., 1877, p. 716.

† *Haas*, Chem. Centralb., 1878, p. 700.

‡ *Buignet*, Ann. Chim. Phys., 1861, iii. Sér., Bd. 61, p. 281.

§ Compare in this connection the different appearance and aggregation of tannin masses in comparatively empty cells, as noted above.

consumption. Now, as far as these investigations go there is, and in their progress it was to me a source of surprise, no evidence to show that this takes place. Rearrangements, alterations, concentration, dilution of tannin there may be, but they all point to the same conclusion, viz., that tannin, once formed, is not used up in the further processes of growth, except, perhaps, in the formation of resin; and in this the evidence completely coincides with the non-transfer of tannin from falling leaves, and from the leaves of evergreens in winter.

It is quite true that the general distribution of tannin in *living* tissues practically coincides with the distribution of starch, or of glucose; but this distribution is equally compatible with either theory, bye product or formative substance. Its absence from sieve-tubes is of importance in this respect, if, as the few notes I have bearing directly upon this lead me to believe it is, indeed, general. Nor is the fact that it may change in quantity in a particular part at different times of direct importance to the question, since it would be, indeed, remarkable were a body which exists dissolved in the cell-sap not to be transferable.

Leaving on one side then the other possibilities for tannin, such as its relations with other secretions, or with the colours of plants, the possibility that by its ready oxidisability it may play some collateral part in plant-chemistry, or that, since it does not furnish a good nidus for fungoid organisms, it may in some way protect the dead or dying parts of the plants from diseases due to their attacks; putting these on one side, evidence does not support the view that tannin functionates as a food-material analogous to starch, glucose, or oil.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from Vol. X., page 305.)

How quickly would Results be Shown?—The effect produced by letting water into such a tilted triangular area as has been described would be most rapid at first, and became gradually less apparent as a larger area had to be filled, for at first it would not be possible to extract a large amount of water, and therefore more would be available for filling up the bed. The pressure of water, on which of course the yield of a well chiefly depends, would be approximately

proportional to the distance away, in the direction of outcrop, at which the bed was saturated, allowance being made in this particular case for increase of dip; whereas, the area to be filled would be proportional to the square of that distance. Taking the data already given as sufficiently accurate, it follows that about seventy-five millions of gallons would be required for the first mile, and it would raise the head of water 9½ feet, whereas two miles would require about four times the amount of water, but would only raise the head nineteen feet, and so on.

Considering, therefore, that the Northampton well resuscitated itself so well in about two years, without assistance, it is evident that the near Marlstone had a considerable amount of water left in it when pumping was stopped, although the pressure was not sufficient to deliver it in large quantities; it thus becomes an indirect proof of the small inclination of the bed near the town.

I have endeavoured to show that there is no natural obstacle to a head of 110 feet of water being obtained at Northampton. Without the aid of headings, a yield of over 800,000 gallons per day was obtained when the artesian rest-level was ninety feet; therefore, with a rest-level of 110 feet, 1,000,000 per day would now be obtained. This would be sufficient for the present use of the town, and perhaps as much as could be expected from a single well. A dozen *dumb-wells* ought to supply this amount of water, and at the same time continuously improve the yield up to the greatest limit. There is no doubt that one of these wells, when empty, and supplied with clear water, could dispose of 1,000,000 gallons in a day, but considering that they would not be empty even when first made, and that the flow of water would be impeded by the filling of sand and gravel, and that that amount of water would not be continuously available, I have assumed a limit of 100,000 gallons per day on an average, or 1,200,000 gallons altogether. This amount, together with that impounded naturally, would give an immediate increase of the water supply, followed by a continuous improvement in the yield up to the maximum amount. A single year would suffice to make the supply equal to the bare necessities of the town, without extraneous aid, for with a daily loss of 400,000 gallons, there would be a residue of 365,000,000 of gallons on the year.

In connection with the available supply of water, it is somewhat important to know if the river grave taps the river. Speaking generally, I should say it does not for the river, in most cases, flows over a good thickness of the dirty alluvial

clay previously described, the river gravel being below. Also the fall of the river from Northampton to the sea is so small that there is always a tendency to further silt up its bed, and so prevent leakage. It was ascertained that there was no leakage from the river into the gravel at the Gas Works, Northampton, when making excavations for a new gasometer; also none was detected when the large culvert was carried across the Cow and Midsummer Meadows to the Sewage Works. On the other hand, a well in the river gravel, near to the St. James End Ironworks, and only a little westward of the Gas Works, evidently tapped the river, for the water always stood at the same level in each after a rest. There was little or no true alluvium where this well was made. One instance where the river was tapped has come under my notice. When digging the foundations for some new buildings at Nun Mills (Mr. Westley's) the alluvium was pierced, and the river gravel reached, the latter dipping in the direction of the old mill at the rate of seven feet in forty. Whilst work was going on pumping had to be continued, but on a particular Sunday it was noticed that the water in the river and the opening made into the gravel stood, as nearly as one could judge, at the same level, and as the water in the river sank during the day, so did that derived from the gravel. Of course both alluvium and gravel may have been much disturbed here when making the original mill and mill-head. The culvert referred to is only a very short distance away from this mill on the other side of the river. Numerous wells have been made to obtain water from the river gravel, but in no other cases than those mentioned, so far as I know, has there been any reason for suspecting that the supply was fed by the river. It, therefore, appears pretty certain that no considerable draining of the river would take place.

The supply of water to the proposed dumb-wells would, during flood time, be equal to their utmost capacity for receiving it, and during nearly half the year very considerable from incipient floods. I have been assured by a gentleman, who knows the Nen valley and its adjacent lands well, that many streams might with advantage be diverted into shallow holes for several months in the year, and some of the disadvantages incident to land drainage thus obviated, but a consideration of this will come better in Part V.

IV.—Would the Water be Pure?

It will be generally admitted that the water usually obtained from the Marlstone, including that supplied to Northampton from the same source, is good. There is no

reason to doubt that the water artificially let into the Marlstone would be equally pure, and there are several decided advantages in collecting and storing the water in underground reservoirs rather than in open ones, which must be more or less evident to everyone.

Flood water and river water in the *early stages* of a flood are more impure than at other times, owing to the washing of lands on or in which impurities have been accumulating, and the displacement of water from springs or subsoils where it has been stagnating, though in the later stages of a flood river water appears to be more than usually pure.* Notwithstanding this, I think I may claim that *the water to be utilised by this scheme would not, in the first instance, be more impure than some which is now used for the supply of towns, after artificial filtration*, whilst the arrangements for purification are *much* more perfect than any adopted by these towns; let me call attention to them.

There are special arrangements for filtering the water before it reaches the well. The flood water can only enter the dumb-well after passing over soil covered with vegetation, then through soil or sand and drain pipes, or, if it comes from the river, through a considerable amount of sand or gravel, and by either of these processes it would be completely clarified. The water which is now obtained from the river gravel is perfectly clear and bright, and contains, as a rule, nothing actually injurious, though the quantity of nitrates present would be, in this case, interpreted as a proof of previous contamination. This speaks well for the bed, though not for the water now contained in it, but with a larger and more rapid circulation of water this suspicious character would diminish, and the total solids become less.

The water would be well filtered in the wells themselves by a quantity of sand and gravel at least five or six times as great as that considered sufficient for the filtration of Thames water by the London Water Companies.

The water would be again filtered in the Marlstone itself, a filtration of a most perfect kind, and probably quite sufficient without any artificial aid. I have no hesitation in saying that there is no artificially collected water in this country so well filtered as this would be before reaching the pumping station.

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* For particulars on this and other points connected with rivers, see "River Water," by C. Meymott Tidy, M.B., M.A., M.S. Journal of Chemical Society, May, 1880.

The water would be well aërated by the fall into the dumb-wells. This aëration is a very important matter in the purification of water, and yet it seems to be rather neglected in most arrangements for the artificial purification of water. The best proof of the value of aëration is found in the fact that the free oxygen in water is always in the inverse ratio of the organic contamination.

Water collected and stored as suggested would be perfectly safe until wanted, it would be of an equable temperature all the year round, *cool and refreshing in summer*, and *not liable to freeze in winter*, in these respects being far superior to water stored in open reservoirs. A large open reservoir must during the summer months breed large numbers of infusorial animals, and although these may be removed by the filter beds, the water is liable, on account of its temperature, to again breed such afterwards.

One other advantage of the underground reservoirs might be here pointed out—*the filter beds cannot be overtaxed so as to supply imperfectly filtered water.* Of the water which is put in, it may be months or even years before that same water is utilised in the town, and in all cases it would amount to a considerable interval of time, because it could only reach the pumping station by pushing other water before it through the filtering medium, and being itself pushed.

The following remarks, quoted from Mr. C. E. de Rance's work "The Water Supply of England and Wales," are very pertinent to the question here dealt with.

"In regard to their general fitness for drinking and cooking, the Rivers Pollution Commissioners classify waters in the order of their excellence, in respect to wholesomeness and palatability as follows:—

Wholesome	1. Spring water 2. Deep well water 3. Upland surface water	Very palatable. (1–2) Moderately palatable. (3–4)
Suspicious	4. Stored rain water 5. Surface water from cultivated land	
Dangerous	6. River water which sewage gets access to 7. Shallow well water	Palatable. (5–7)

The value of spring and deep well water is not merely due to their great intrinsic chemical purity and palatability, but to their being peculiarly suited for domestic supply, from their almost invariable clearness, transparency and brilliancy, and their uniformity of temperature throughout the year, rendering

them cool and refreshing in summer, and preventing their readily freezing in winter; and their utilisation and conservation appear to be a matter not only worthy of enquiry, but one of National importance, and to demand Imperial legislation.

The Commissioners state that only water derived from wells more than 100 feet in depth, and from deep-seated springs can be considered reasonably safe, for in these the organic matter contained in the water is rapidly oxidised in percolation through porous and aërated soil and permeable rock."

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 21.)

WILLIAM SCOTT, "STOURBRIDGE AND ITS VICINITY."

† **J. setaceus.** Morasses, banks of streams, and other humid sites.

This must be an error for Scirpus setaceus, but this plant is mentioned further on.

* **Scirpus palustris.** Pool near the Heath.

‡ **S. lacustris.** Chickhill Pool, Himley, and other localities in Stafford.

This is the plant communicated to Purton as S. carinatus.

* **S. setaceus.** Pedmore Common; field adjoining Mount Carmel.

‡ * **S. acicularis.** Reservoirs, &c.

Query county ?

‡ **S. pauciflorus.** Reservoirs, &c.

Query county ?

* **Eriophorum** *(angustifolium)*. Meadows in the Vale of Stour; Pedmore Common.

Carex paniculata. Marshes near the Heath and on the Stour.

† **C. teretiuscula.** Marshes near the Heath; banks of Stour; Harborough Pool.

I suspect an error for a narrow form of C. paniculata.

C. vulpina. Banks of Stour and canals.

C. muricata. Hill Pool Holloway; Ismere.

* **C. remota.** Hagley Park.

C. ovalis. Hungary Hill.

† **C. stricta.** Marshes. *An error.*

† **C. cæspitosa.** Carnation grass. Uplands near Wychbury. *An error.*

C. cæspitosa, Good., is C. vulgaris, Fries; this however cannot be the plant intended. I suspect C. stricta to be an error for C. vulgaris, and C. cæspitosa an error for C. glauca.

† **C. limosa.** Wychbury Uplands. *An error.*

It is difficult to imagine what can have been intended by this name.

C. pallescens. Cradley Park.

C. strigosa. Cradley Park.

C. sylvatica. Cradley Park.

† **C. distans.** Cradley Park. *An error.*

C. fulva. Cradley Park.

* **C. flava.** Fields near Cradley. *Probably var. minor.*

* **C. pendula.** Harborough Pool.

C. hirta. Banks of streams.

‡ **C. vesicaria.** Reservoir. *Query where?* Probably in Stafford.

C. riparia. Banks of Stour.

‡ **Panicum verticillatum.** *No locality.*

Anthoxanthum odoratum. Grass fields.

Phleum nodosum *(a var. of P. pratense).*

Agrostis alba.
A. stolonifera. } *Forms of one species.*

A. nigra. *Form of A. vulgaris.*

Arundo colorata. Near Broughton Village.

A. colorata (Hortus Kewensis, p. 116), is Phalaris arundinacea, L.

A. Phragmites. S. of Worcester.

Milium effusum. Woodlands.

* **Aira caryophyllea.** Commons.

A. præcox. Commons.

A. flexuosa. Woods and Commons.

A. *(Catabrosa)* **aquatica.** Lusbridge Brook.

* **A.** *(Koeleria)* **cristata.** Commons.

It is strange that this grass, which is comparatively rare, should be given without locality.

* **Avena elatior** *(Arrhenatherum avenaceum).* Grass fields.

A. flavescens. Grass fields.

Holcus mollis.

H. lanatus.

‡ **H. bulbosus.**

I suppose a bulbous variety of mollis to be intended by this name.

* **Melica uniflora.** Cradley Park.

† **M. nutans.** Woods.

It is surprising that this rare grass should be inserted without locality. It does not now occur in the Stourbridge neighbourhood. I suspect an error.

* **M.** (*Molinia*) **cærulea.** Marsh near Pedmore Common.

Poa trivialis.

P. pratensis.

‡ **P. elatior.**

I do not know what was intended by this name.

P. (*Glyceria*) **aquatica.** Rivers and morasses.

P. (*Glyceria*) **fluitans** Lusbridge Brook, Broughton Brook near the village.

† **P.** (*Sclerochloa*) **distans.**

Must, I think, be an error.

P. (*Triodia*) **decumbens.**

† **Briza minor.** Grass fields.

Must be an error for B. media.

Cynosurus cristatus. Roads, fields.

Dactylis glomerata. Commons and fields.

Festuca Myurus. Commons and roadsides.

* **F. ovina.** Commons and hedge banks.

F. rubra. Commons.

* **F. duriuscula** (*var. of preceding*). Commons.

* **F. loliacea.** Cradley Field.

F. pratensis. Fields.

‡ **F. arrow-headed.** A temporary name. Pedmore rocks; Cookley; Bredon Hill.

What is meant by this?

* **Bromus giganteus.** Woods, &c.

B. secalinus. Woods, &c.

B. sterilis. Woods, &c.

* **B. sylvaticus** (*Brachypodium sylvaticum*). Woods, &c.

Triticum repens.

† **T. junceum.** Fields between Pedmore and Hagley. *A very doubtful record.*

T. caninum. Woodlands.

* **Hordeum pratense.** Scattered variously, luxuriant. Beckford near Evesham.

Lolium perenne. Grass fields.

* **Nardus stricta.** Commons.

* **Asplenium Trichomanes.** Cookley.

Scolopendrium (*vulgare*). Rocks near Bell's Mill; Chaddesley; Hill Pool; very rare.

‡ **Lycopodium clavatum.** Whittington Common (*Stafford*); very rare.

Scott deserves our gratitude notwithstanding the imperfection of his work, as his Catalogue yields many new county records.

(*To be continued.*) 6 5 7

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

III.—BINOCULAR VISION.

FROM A LECTURE ON "ARTIFICIAL EYES," 1867.

[NOTE.—Numbers I. and II. of these "Passages" will be found in the "Midland Naturalist, Vol. I., page 29, and Vol. II., page 29. The series was cut short by other engagements. I propose now to continue it.—F. T. M.]

Having two eyes, why do we not see everything double? The first answer is that we do see many things double; more, probably, than most of us are conscious of. There are certain conditions under which we see things double, and certain others under which we see them as one only. Probably infants in their earliest months see everything double. If you hold up your finger between your face and some other object not very far off, and then look at the finger you will see two images of the other object, and *vice versâ*. If you are foolish enough to drink beer or brandy to excess, so as to over-stimulate and confuse the brain, you will most likely experience double vision, accompanied by other curious and undesirable symptoms.

Single vision with two eyes, like the hearing of one sound with two ears, seems to depend upon a combining power which the healthy brain possesses, partly due to the fact that the optic nerves are actually united within the brain, and partly to experience acquired in very early life. But one necessary condition is that the eyes should be both directed

to the same point at the same time. It may be easily conceived that if both eyes are turned to the same point, so that there is on each retina a precisely similar picture, the two impressions coinciding in the brain may be received as one. But in looking at any solid object the two pictures formed in the eyes are not precisely similar; the left eye sees a little more of the left side of the object, and the right eye a little more of the right side of it. Each eye sees a little way round the corner on its own side, so that there is a slight difference in the two pictures. What, then, does the brain do in this case? Instead of making a confused image of the whole, it combines what is alike in the two pictures, and adds on the surplus at each side, the result being an impression of *thickness*, as well as of length and breadth, of relief, of comparative distances, of perspective.

Shut one eye, and you will find that everything seems flatter, more like a painted picture than when you see it with two eyes. A person suddenly deprived of the use of one eye feels at a loss about the distances of objects at first, but the brain soon learns to work under its altered conditions, and after a few days' experience the sense of perspective is nearly as strong as before.

When you look at a landscape with the head inverted (looking under the arm or between the legs), you say "It is like a picture!" What you mean is that the perspective has in a great measure disappeared. The foreground has gone back, and the background has come forward. Everything looks nearly in the same plane, and the effect is strange and rather pretty. The reason is that the brain is not accustomed to estimate distances with the eyes in that position, and cannot do it completely on a sudden demand. If you thought it worth while to remain upside down for a week you would find the perspective come back again, and your pretty picture fade away into a real landscape.

On this principle of binocular vision Sir David Brewster founded his invention of the stereoscope, one of the most beautiful and interesting of scientific toys. Scenes and objects which are far removed out of our sight it sets before us with life-like roundness and reality. It makes artificially upon the retinæ of the eyes the two slightly different pictures which the right and left eyes would make for themselves if they had the real object before them. The brain does its work regardless of the deception. What is alike in the two impressions is combined into one, the surplus is added at each side, and the effect of relief is produced as perfectly as if the object itself had sent its light-rays into the eyes.

The essential elements in stereoscopic pictures are, of course, that they should be taken from two points of view not less than 2½ inches asunder, which is the average distance of eyes from centre to centre; and that they should be fixed upon the card so that there is the same distance between them, point for point. If they are taken from points of view less distant than 2½ inches, the proper effect of relief will not be produced. If that distance is much exceeded an exaggerated relief will be the result. In taking views of distant objects this exaggerated relief is always given, because without it no stereoscopic effect would be perceived. Our natural eyes being only 2½ inches apart, are not able to see round the corners of any object which is more than 30 or 40 feet distant from us. In taking stereoscopic views of objects or landscapes more distant than this, the points of view are more widely separated in order to get the effect which the eyes alone could not get, and no doubt this unnatural perspective makes the resulting picture in the stereoscope still more surprising and wonderful to us.

The instrument itself is a very simple but very ingenious contrivance. Its object is to refract the light-rays from two pictures so that they shall appear to the eyes to emanate from one only. This is done by taking a common double-convex lens, cutting it across the centre into two halves, and turning these two halves round so that their thin edges come together and their thick parts are turned outward, right and left. The two halves are then cut circular or square, and fixed into the frame, and the result is that the two pictures appear to overlie one another just as if the eyes were converging upon one object.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Exposition of Chapters XII. and XIII.

Multiplication of the Human Race.

BY ALFRED HILL, M.D., F.I.C.

The inverse variation between the generative function and the preservation of the individual, or, as Mr. Spencer otherwise expresses it, between Genesis and Individuation, is universal. Man's very slow rate of multiplication—lower

than that of any mammal except the elephant—is the natural result, says Mr. Spencer, of his higher evolution, and changes of bulk, structure, or expenditure will be found to be the causes of changes in the degrees of his fertility. Where there is much expenditure, as in man and most of the higher animals, genesis commences only when growth and development are nearly completed, continues during the prime of life, and ceases when the vigour declines. There is, too, a period when fecundity culminates—in women it increases up to about the age of twenty-five years, but gradually wanes after the age of thirty; increase in weight and size of the offspring also accompany increase of fecundity, and *vice-versâ*, both in cases of uniparous and pluriparous animals, while a too early bearing of young causes arrest of growth and enfeeblement of constitution. There is, in fact, evidence that what causes increase or decrease of genesis in other creatures does so in man, though only few unobjectionable comparisons can be made, because the human races differ considerably in size, and notably in their degrees of cerebral development; the quantities and qualities of their food are unlike, greatly on account of differences in climate, and their expenditures in bodily, and more particularly mental, action are extremely unequal.

That increased fertility accompanies a nutrition in excess of expenditure is shown by contrasting populations of the same race, or of allied races, which are differently nourished, and Mr. Spencer cites three examples of this:—

(1.) That of the idle, stupid, and self-indulgent Boers, who not uncommonly have from twelve to twenty children.

(2.) That of the cruelly used Hottentots, who do all the work for the Boers, and who seldom have more than two or three children, while the well-fed Kaffirs are very prolific.

(3.) That of the French Canadians, who live in a region where subsistence is easily obtained, and who pass a considerable portion of the year in idleness, and have large families, in contrast with the Anglo-Saxon Canadians, who, leading lives of excessive activity, have a low fertility. Mr. Spencer argues that though the case of the Irish peasantry may appear adverse to this view, their rapid multiplication may be due to earlier marriages, and consequent quicker succession of generations, to greater generality of marriage, and particularly to the fact that they obtain a return of food that is large in proportion to the amount of labour expended in procuring it. A good surplus is, therefore, left for genesis—a greater surplus probably than remains to the English peasantry, who,

though better fed, are harder worked. Mr. Spencer draws the conclusion that in the human race, as in all other races, such absolute or relative abundance of nutriment as leaves a large excess after defraying the cost of carrying on parental life, is accompanied by a high rate of genesis.

The converse truth that relative increase of expenditure, leaving a diminished surplus, reduces the degree of fertility is next dwelt upon. Much bodily labour is said to render women less prolific, and there is some evidence of this. According to De Boismont, of France, and Dr. Szukits, of Austria, the reproductive age is reached a year later by women of the labouring classes than by those of the middle class. The low rate of increase in France is probably due partly to the hard work thrown on the women by the abstraction of men for non-productive occupations, military and civil, while the higher rate of increase in England is probably furthered by the easier lives which English women lead.

Mental labour is more easily shown to be the cause of absolute or relative infertility; for instance, upper-class girls have a less productive power than poor girls, though their food is better; the greater tax on their brains reacts on their physique. This diminution of reproductive power is shown by absolute sterility, earlier cessation of child-bearing, and frequent inability to suckle their infants. The antagonism between Genesis and Individuation is not often shown in men by suppression of generative power consequent on unusual expenditure in bodily action, owing to the cost of reproduction being much less in men than in women, but the ancient *Athletæ* are said to have rarely had children, while "trainers" insist on continence. Cerebral expenditure is believed to diminish generative power, and intense application to mathematics and the excitement of gambling are said to have had this result, while men of unusual mental activity often leave no offspring.

Two objections have to be guarded against here. The first objection is that since civilised races are on the average larger, more complex, and more active than uncivilised, they ought, according to the alleged general law, to be less prolific, whereas there is no evidence to prove that they are so; on the whole, they seem rather the reverse. The answer is that, were all other things equal, these superior varieties of men would have inferior rates of increase, but other things are not equal. Domesticated animals are more fertile than wild ones; the causes are the same that render civilised more fertile than savage men. Then there are differences in the amount of food. Many races with low rates of mortality are

underfed. They eat their food raw, instead of cooked, prepared, and selected, so that their food costs more to masticate and digest. They get their food irregularly—short periods of gluttony alternate with long periods of want. Then, again, the supposed greater consumption in muscular action undergone by civilised men than by savages is only apparent. The chase is very laborious, and the uncivilised not only undergo great exertion in seeking and securing odds and ends of wild food, they lack good shelter and protection from cold, insects, and other sources of wear and tear.

A kindred objection is that there are cases where there are high powers both of self-preservation and race-propagation. This result is the consequence of "a goodness of constitution," resulting in a better internal utilisation of materials. To illustrate this, Mr. Spencer takes the case of a steam engine. The fuel he compares with food, the steam employed in working the engine with Individuation, and the waste steam with Genesis. Of these conditions several variations are possible. There may be a structural or organic change of proportion by enlarging or diminishing the safety valve, &c. There may be a functional change of proportion owing to the engine having to draw a heavier load or maintain a higher speed, and *vice-versâ*, and there may be coincident variations such as that produced by the greater quantity of steam supplied by the use of more or better fuel. One case of coincident variation is parallel with the case under consideration—that of the augmentation of individual expenditure and of reproductive energy that may be caused by a superiority of some organ on which the utilising of materials depends—it is where more steam is produced from a given weight of fuel by improvement of the steam generating apparatus.

Thus far, says Mr. Spencer, "we have observed how by their extremely high evolution and extremely low fertility mankind display the inverse variation between Individuation and Genesis in one of its extremes. And we have also observed how mankind, like other kinds, are functionally changed in their rates of multiplication by changes of conditions. But we have not observed how alteration of structure in man entails alteration of fertility." This is too complicated a problem to be dealt with otherwise than deductively.

Human Population in the Future.

The Evolution of Man must be of the same nature, says Mr. Spencer, as Evolution in general. *Structural* Evolution may consist in greater integration, or greater differentiation, or both; in other words in larger size, greater heterogeneity

and definiteness, or both. *Functional* Evolution may consist in more actions, greater varieties of actions, or both, resulting in more complete co-ordination of actions, in other words, "an advance towards completion of that continuous adjustment of internal to external relations which constitutes life."

Mr. Spencer pauses here to enquire in what particular way the higher life may manifest itself. He considers that it will probably not show itself in any considerable degree in strength or in agility, though it may to some extent in mechanical skill, but that it will most likely manifest itself in intelligence, for which there is ample room for advance, and in morality. There will be greater exertion of the will to do what our intelligence tells us we ought to do. In short, this more perfect co-ordination of actions is likely to take mainly the direction of a higher intellectual and emotional development.

This conclusion is strengthened by an enquiry into the causes which are to bring about such results. Evolution is never spontaneous; all modifications, structural or functional, must depend on surrounding conditions. What are the changes in the environment to which the human organism has been adjusting and will continue to adjust itself? How, too, do they necessitate a higher condition of the organism?

While danger of death from predatory animals and from tribal combinations lessens as men grow more numerous, that from deficiency of food increases. Growth of population is therefore a permanent cause of modification to which civilised men are exposed. This constant increase of population beyond the means of subsistence stimulates the gradual growth of skill, intelligence, and self-control. Without this pressure of competition there would be no necessity for more thought and energy to be applied to the business of life, and growth of mental power would cease. Nothing but necessity could induce men to submit to the discipline of labour and self-denial, and nothing but this discipline could produce a continued progression. Nature, in fact, secures each step by a succession of trials; all mankind subject themselves more or less to the discipline, but all do not advance under it, and only those survive who do progress, while those who are not so stimulated to greater activity are on the way to extinction, as recently exemplified in the case of Ireland. Premature death operates in the same direction, for "natural selection" causes the fittest to survive. In this way there is a constant progress towards higher skill, intelligence, and self-regulation, better co-ordination of actions—a more complete life.

We have thus arrived at the proposition that excess of fertility is itself the cause of man's further evolution; the corollary, says Mr. Spencer, is that man's further evolution thus effected necessitates a decline in his fertility. The future progress of civilisation produced by the never ceasing pressure of population will be accompanied by an enhanced cost of Individuation, especially in nervous structure and function, an increase of the great nervous centres in mass, complexity, and activity. More emotion is the correlative of a larger brain, higher feeling of a more complex brain, more feeling and thought of an active brain, so that the nervous system must become a heavier tax on the organism. Already the brain of the civilised man is nearly thirty per cent. larger, and is more complex in its convolutions, than that of the savage. Mr. Spencer concludes, therefore, that the particular kind of evolution, which man is hereafter to undergo, may be expected to cause a decline in his power of reproduction. He would not let us assume, however, that this greater expenditure in nervous action necessarily implies a more mentally-laborious life. The greater emotional and intellectual power and activity will gradually become organic, spontaneous, and pleasurable, just as the mental effort of an accomplished man is trifling compared with that of an illiterate one.

What, then, is to be the limit of this progress? As long as fertility exceeds mortality the population must increase; as long as there is pressure on the means of subsistence further mental development and further diminution of fertility must result. The change must therefore go on until the rate of multiplication exactly equals that of mortality. At first sight this would seem to imply that eventually each pair will rarely have more than two offspring, but this is not so, as the number of premature deaths can never become so small as to allow the rate of multiplication to fall so low. It is manifest, however, that in the end pressure of population and its accompanying evils will disappear, and only normal and pleasurable activity will be required from each individual, for cessation in the degree of fertility implies cessation in the development of the nervous system, which further implies that the latter has become equal to the work demanded of it—has not more to do than is natural to it. But exercise of the faculties within natural bounds constitutes gratification, therefore in the end the obtainment of subsistence and discharge of all the parental and social duties will require just that kind and that amount of action which are needful to health and happiness. We see then, says Mr. Spencer, that the

antagonism of Individuation and Genesis ensures the final attainment of the highest form of maintenance of race—the greatest amount of life possible, and the fewest number of births and deaths. Fertility has brought about civilisation, civilisation will diminish fertility and destroy its excess. From the beginning pressure of population has been the cause of progress. It produced the original diffusion of the race, it compelled man to take to agriculture, it forced men into the social state and developed the social sentiments, it has stimulated us to increased skill and intelligence, and it is daily thrusting us into more mutually-dependent relationships, and, after having caused the due peopling of the globe, and the raising of all its habitable parts into the highest state of culture, and developed the intellect into complete competency for its work, and the feelings into complete fitness for social life, it must gradually finish its work and bring itself to an end. Evolution is, in fact, an advance towards equilibrium.

He concludes by observing that the final result is that "in approaching an equilibrium between his nature and the ever varying circumstances of his inorganic environment, and in approaching an equilibrium between his nature and all the requirements of the social state, man is at the same time approaching that lowest limit of fertility at which the equilibrium of population is maintained by the addition of as many infants as there are subtractions by deaths in old age. Changes numerical, social, organic must by their mutual influences work unceasingly towards a state of harmony—a state in which each of the factors is just equal to its work."

[These Expositions of Herbert Spencer's "Principles of Biology" are now concluded. They commenced in vol. VII., p. 35.]

Notes.

Hoar Frost in January, 1888.—Fact and Theory.—Having occasion yesterday at noon (12th January) to make an observation with an anemometer in the mouth of a rectangular wooden pipe, fixed vertically into the ground and communicating ventilation to some underground excavations of a fire-clay mine near here; it was necessary to remove a square of wire gauze (whose meshes were $\frac{3}{16}$ inch square), which had been nailed over the mouth of the said pipe to protect it. Now, covering the upper surface of this wire gauze was a beautifully evenly-formed layer or cake of cellular ice or hoar frost, very much resembling the comb of the honey bee, only the cells were four-sided instead of

six. I noticed that the walls of these ice-cells had formed upon the upper surfaces of the wires of the gauze, and were about the same thickness as the wires; that the cells themselves all sloped very much —probably at about an angle of 45° with the horizontal piece of gauze —and that their axes all lay in the same direction, namely, facing that from which the wind blew (N.W., but almost a dead calm, with a very steady barometer at about 30·70 s.l.). The length of the cells was about half-an-inch, though near the edges of the pipe they were shorter. The direction of the air flowing through the gauze was inwards and vertically downwards, the quantity being about 100 cubic feet per minute, the area of mouth of pipe being 50 square inches. A thick fog prevailed, but the air temperature was from two to three degrees *above* freezing point, and there had been no frost the night before. This peculiar formation of frozen fog seems to me to be accounted for in this way:—The cold foggy air being sucked rapidly through the meshes of the gauze became so much reduced in temperature, due to *rarefaction*, as to cause it to fall below 32° F., and to be converted into hoar frost or ice, and, as long as the conditions remained the same, the ice cells grew outwards or in the direction of the in-rushing air, coming, as already mentioned, from the N.W. I have often observed, too, that long-pointed horizontal crystals of hoar frost rapidly form along a door-sill, just beneath the bottom of the door, in cold thick-foggy weather during a calm. When this is the case a strong current of air is passing through the chink *from* the open air. In these instances also the ice-needles grow outwards, or in the direction whence the air comes in. I suppose here, again, we have the same cause, namely, reduction of temperature, causing ice to form as described. But whether such objects as spiders' webs, long grass, twigs, sharp edges of posts, telegraph wires, &c., are directly concerned in the formation of hoar frost or not I am scarcely able to say, unless it be that they cause a local lowering of temperature and, therefore, a deposition of ice particles. Whether there is anything new in this idea of mine I cannot say, but I do not find the (?) *theory* in print.

Overseal, 14th January, 1888. W. S. GRESLEY.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION.—January 17th. Chairman, Mr. T. H. Waller, B.A., B.Sc. Mr. Waller, B.A., B.Sc., was re-elected President of the Section; Mr. Udall, F.G.S., was re-elected Secretary of the Section; Mr. Thos. E. Bolton, son of the late lamented Curator, was unanimously elected a life member. Specimens were exhibited by Mr. Mantell of Upper Cambrian rocks showing Oleni in black shales, and Dictyonema in grey shales. A paper was read by Mr. Waller—"Notes on Serpentine Rocks," illustrated by microscopic preparations, including Picrite, Scyelite, &c.

VOLITION.*

BY CONSTANCE C. W. NADEN.

What is a *voluntary action?* It is very easy to answer. "An action controlled by the will," or "An action determined by motives;" but we are only plunged into deeper perplexities, for we now have to seek a definition of "Will" and "Motive"—two elusive Will-o'-the-wisps, which will lead us on till we lose footing in metaphysical swamps. Even if we turn away from metaphysics altogether, and question anatomy and physiology, we are not much enlightened, for many actions which follow on stimulation of the so-called "voluntary" muscles are by no means voluntary. The only way of getting an answer is, apparently, by interrogating our own consciousness; the distinction between volition and automatism or volition and impulse is primarily psychological. It has, as I hope to show, its grounds in physiology also; but, as a mode of classifying actions, it should be reserved exclusively for psychology.

Under the term "action" I shall include every modification of the organism which results from its own internal activity. It would be wrong to confine the word to those external manifestations which make up the visible life; for although I *will* to move my arm, and not to contract a set of muscles, still the muscular contraction is the immediate sequence of my volition. I eat to live, not to excite the gastric glands; but the gastric glands help to carry out my purpose by their involuntary and unconscious activity. An action, then, may be a muscular contraction, a secreting process, or a neural process, or the inhibition of any of these.

First, let us look within for the meaning of "Volition" and "Voluntary," putting aside all preconceived notions about the freedom of the will, and its power of proceeding in diametrically opposite directions under precisely similar conditions; putting aside those questions of "fate, free-will, foreknowledge absolute," which occupied Milton's fallen angels, and confining ourselves to the facts of mental experience. I think we shall find that what, in common parlance, we mean by a "voluntary action" is simply an *action accompanied or immediately preceded by a conscious mental*

* Read at a Meeting of the Mason College Physiological Society, February 8th, 1887.

effort in its own direction. I cannot find that anything more than this is involved in the idea. Conflicting motives appear only in the very highest class of voluntary actions; in those which follow a certain period of reflection and deliberation, and which, to pre-evolutional psychology, were the chosen types of volition. But the embryology of "Will" is more instructive than its mature development.

Even the "conscious mental effort," which may seem so trivial an expression to denote the awful majesty with which "Will" has been invested, is sometimes so slight as to be barely perceptible. The boundary between volition and automatism is very vaguely defined. I set out to walk; the first step is not automatic in the sense in which the succeeding steps are automatic, and yet the "conscious mental effort" is reduced to a minimum. Still it is there; and if my foot happens to be sore, the effort will be much more distinctly felt, and will increase with each step, instead of ceasing to exist. If my mind is passive, and open to every trivial fleeting suggestion, then its processes are effortless; but directly I begin to *attend* to anything there is a conscious effort, which corresponds to an actual nervous tension; but if the subject is interesting to me, and is one with which I am familiar, the effort may disappear from consciousness after the first moment. We understand a speaker in our own language without effort; his meaning comes to us whether we will or no; but there is always a certain effort required to follow a speaker in a language not perfectly familiar to us.

But instead of describing voluntary actions, I shall begin by very briefly classifying involuntary ones, not only because they form by far the larger division, but also because their characteristic physiological conditions are more positive, more definite, and hence more easily understood.

Involuntary actions fall naturally into two great classes, the *automatic* and the *impulsive.*

Automatism implies the existence of a more or less complete nervous and muscular mechanism, which renders the exercise of certain functions easy, and, under given circumstances, inevitable. The current of nerve-energy always flows in the direction of least resistance; in the case of automatic actions, there is no perceptible resistance along a certain definite line, while all other lines are more or less blocked.

Lowest of all are the *primary* automatic actions, which have nothing to do with consciousness, and are performed perfectly by the new-born infant. These include breathing, coughing, sucking, the organic functions, and various reflex actions depending upon the medulla oblongata, the spinal

cord, or the sympathetic ganglia. These do not require the co-operation of the cerebrum, and may be performed by an acephalous child.

Next in order come the *secondary* automatic actions, which do at first require a conscious effort, but which after frequent repetition become organic habits so that they are effortless, and often unconscious. But some of these, indeed perhaps the larger part, avail themselves of an inherited but imperfect nervous mechanism, which would be better called an organic predisposition. These may be subdivided into three groups.

The first group is called *excito-motor*, and depends upon the activity of the spinal cord; it includes the movements of the limbs in walking, running, grasping, &c.

The second group depends upon the sensory ganglia at the base of the brain, and includes the closure of the lid when a bright light strikes the eye, the following of light with the eye, the shifting from an uncomfortable position; all of which may occur when the attention is completely absorbed by other ideas. These two groups may or may not be accompanied by consciousness.

The third group is *ideo-motor*, and depends on the cerebral hemispheres; including the various movements of features and limbs expressive of emotion; the shudder excited by some horrible story; the cries uttered in presence of some real or imagined danger. There are, however, involuntary cerebral processes which are ideal, but not motor, or which only issue in motion after a more or less lengthened interval. Such are the effortless successions of thoughts and feelings with which great part of our time is filled; such are those processes which represent the physical side of thought and feeling, but never pass the threshold of consciousness, and make themselves known only by their results. Dreams also, and the phenomena of somnambulism and hypnotism, belong to the ideal or the ideo-motor group. These last never indeed, or rarely, constitute organised habits in the sense in which walking, blinking, shuddering are habitual. But they always are the outcome of mental habits. For instance, the mathematician, who solved a problem in his sleep which he was unable to solve awake, certainly was not in the *habit* of solving that special problem. But he had a mathematical habit of mind; an organised mode of mental association which enabled him to strike into likely paths, and to do this all the better in the absence of the nervous tension caused by anxiety to succeed. So Coleridge uttered interminable monologues, and composed "Kubla Khan" in sleep, as the result of an

organic predisposition consolidated into habit—the habit of associating ideas metaphysically and poetically; aided, doubtless, by the other habit of taking opium.

This mention of opium leads us to the second great class of involuntary actions, which I shall call *impulsive*. These, too, may be divided into excito-motor, sensori-motor, and ideo-motor groups. They follow upon unusually strong internal or external stimuli, and are not necessarily connected in any way with habit, except in structures like the spinal cord, all of whose normal functions are automatic. For instance, when the foot is tickled, and the leg in consequence drawn up with some force, the action may either be said to be automatic or to be impulsive. But when, the cord having been stimulated by strychnia, the whole body is thrown into convulsions at a touch, then the movements are impulsive, although the special form they take is determined by automatism. Similar remarks may be made respecting unusually strong stimulation of the sensory organs. It is in ideo-motor actions that the contrast between automatism and impulse appears most strongly; although here, too, the path of an impulse, and its outward manifestations, may be determined by ingrained habit. Thus a similar emotion of anger may express itself in one individual by a blow or a stab, in another by a cutting phrase. Again, an impulse may clear a path, which remains open and initiates a new habit. It is a truism of moralists, that yielding to our passions weakens the moral nature; that is, makes it the prey of evil or exhausting habits.

From the effects of insanity and from the influence of various alcoholic and other stimulants are drawn the most striking examples of *impulsive* actions. The automatic powers are often heightened, the bodily and mental vigour seems for a time increased, and the superfluous though diseased and precarious energy overflows into new, or at least into unaccustomed channels. Frequently illusions occur, so vivid and so insistent as to hurry the insane or intoxicated person to extraordinary and often terrible deeds, of which in his normal condition he would be incapable, but which are now accomplished in spite of the strenuous efforts which he sometimes makes to desist from them. Of course the impulse must expend a force greater than that which is opposed to it by volition; but on the side of the conquered impulse the force is felt as *energy*, while on the side of the conquered volition it is felt as *effort*. It is true that when the impulse is not very strong, it can conquer volition only by a conscious effort; that is, by becoming itself in some degree volitional.

For there are degrees of volition, as there are degrees of consciousness. To the opposite case of volition being able to conquer impulse, I shall return later.

I have briefly sketched the two classes of involuntary actions. The first thing that will strike is that their union under the one order "involuntary" is, from a physiological point of view, very artificial. In the one class, we have a line of least resistance, which is either innate, or has been formed by repeated efforts or impulses, so that the least stimulus may set up a wave of nerve-energy, which, journeying along prepared channels, initiates a complex series of purposive movements. This series, however complex, is *predetermined;* that is, given the same stimulus, and the movements will be the same. Tickle the back of the throat, and there is a cough; bring a bright light suddenly near to the eye, and the lid will quickly close.

In the second class there is an unusually strong stimulus, which can either communicate increased energy to ordinary automatic actions, or can set up a molecular vibration so energetic that it travels along unaccustomed channels with irresistible force. The resulting movements are indeterminate; that is, they cannot be definitely predicted; and they may be purposive or wholly at random.

Although the two conditions—the prepared channel and the violent stimulus—frequently unite in the same action, and although their respective results are not always distinctly separable, still as *conditions* they have evidently nothing in common. Then, in both classes, we find actions of all grades —excito-motor, sensori-motor, ideo-motor, and also cerebral actions demanding intricate combinations of thought and of imagery. In but one respect all the grades of the two classes agree; they are not preceded by any conscious mental effort. In the one case, the want of effort is due to the easiness of the track; in the other, it is due to the energy of the stimulus.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 43.)

It is one of the difficulties of the task I have undertaken that new materials present themselves during the progress of the work, and sometimes disturb the chronological arrangement of the authors quoted. I had limited my examination of Withering's "Botanical Arrangement" to the first three

editions published in his life-time. But I have found it necessary to read through the fourth edition also, edited by his son, and published in 1801, two years after the author's death. This has yielded, among others, the following records:—

Cardamine pratensis, var. 2, double flowered, p. 568. In a field S.W. of the Tap House at Hagley. *This must be the plant referred to by Scott as Cardamine impatiens.*

Œnothera biennis, p. 361. In Worcestershire; Rev. Mr. Bourne. *This is included in Purton's list, on the same authority. The notice in Withering must take precedence of that in Purton, "Midland Flora," p. 195; "Midland Naturalist," Vol. X., p. 222.*

Saxifraga umbrosa, p. 394. In a sloping field a little below Moseley Common; Mr. W. Evans. *Must have been a garden escape.*

Angelica Archangelica, p. 293. Broadmoore, about 7 miles N.W. from Birmingham. *N.W. must be a mistake for S.W. A. Archangelica is not a British plant, and not naturalised in this country.*

* **Erigeron acre**, p. 703. Lime rocks, Dudley.

Previously mentioned by Dr. Sheward as growing on walls about Worcester Cathedral.

Hieracium sylvaticum, p. 671. *(H. vulgatum. Fries.)* Dudley Castle Hill. *This must take precedence of Perry's record.*

Euphorbia Characias, p. 443. On Malvern Hill, between the Inn and the Wells. *This is not a British plant, and not naturalised.*

Narcissus biflorus, p. 325. In fields near Yardley Wood Pool, Worcestershire, together with N. Pseudo-narcissus.

This must take precedence of the record in Scott.

Osmunda regalis, p. 747. This plant, though before not to be found for many miles around Birmingham, lately appeared on a butt on Moseley Common, artificially made with mud from a deep pit, in which the seeds had probably lain for a great length of time. It continued to flourish so long as the butt was permitted to remain, but has probably now again disappeared.

It will appear in the sequel that it existed at Moseley up to the enclosure of the Green in 1840, or about that time.

Cardamine pratensis and Osmunda regalis are new records. Œnothera biennis must take precedence of the record in Purton, Hieracium sylvaticum of the record by Perry, and Narcissus biflorus of the record in Scott.

In order to be sure that I have missed no other Worcestershire plants recorded by the Witherings, I have read through the seventh edition of the "Arrangement," that is, the fourth edition edited by the son, published in 1830. This contains many notices by Purton and other contemporary botanists, and, among others, a reference, Vol. II., p. 46, to the discovery of Epipactis purpurata, as recorded in the

"English Flora" of Sir James Edward Smith. The publication of this work in four vols., 8vo, was commenced in 1824. In the fourth volume, published in 1828, p. 41, we read as follows:—"Epipactis purpurata.—Parasitical on the stump of a maple or hazel, in a wood near the Noris Farm, at Leigh, Worcestershire, in 1807. Rev. Dr. Abbot. . . . 'Root certainly parasitical. Whole plant, when fresh, glowing with a beautiful red lilac colour.' . . . Stem about a foot high. . . . Whether my late friend, to whom I am obliged for my only specimen, found any more, I cannot tell, but I hope this account may lead to a further discovery of so curious and interesting a plant, which cannot be referred to any known species."

It will be convenient to supply in this place some omissions made in the extracts from Purton's Midland Flora; "Midland Naturalist," pp. 221, 225, and pp. 255, 257.

Aristolochia Clematitis. Vol. II., p. 430. Foot note.—"This very rare and singular plant was discovered by Miss Mary Anne Rawlins, of Pophills, growing at Chaddesley, near Kidderminster." This, although established in a few localities, is not a native plant, and Purton gives no explanation of the circumstances under which it was found.

The "Additions and Corrections," forming part 2 of the 3rd volume of Purton, 1821, pp. 335—386, escaped my notice when examining the work of that author. The following is a list of them so far as they relate to the County of Worcester:—

* **Helleborus viridis.** Glasshampton; Mrs. Gardner.

H. fœtidus. Southstone's Rock; Mrs. Gardner. Hagley; Mr. Hickman.

* **Aquilegia vulgaris.** Near Lickhill; Hickman.

* **Brassica Napus.** Oldington; Hickman.

* **Cardamine amara.** Stourport, in a meadow of Mr. Worthington's; Hickman. Wilden; Mrs. Gardner.

* **C. impatiens.** Areley Wood; Mrs. Gardner.

Thlaspi arvense. Lickhill; Hickman.

* **Dianthus deltoides.** Dunley; Mrs. Gardner.

* **Geranium phæum.** Cradley Park; Scott.

Euonymus europæus. Blackstone Rock, near Bewdley; Scott.

* **Lathyrus sylvestris.** Woods near Pershore; T. P.

* **L. Nissolia.** Glasshampton; Mrs. Gardner.

* **L. Aphaca.** Grove Coppice, near Stourport; Hickman.

* **Comarum palustre.** Hartlebury Common; Mrs. Gardner.

Rubus Idæus. In woods, abundantly, near Kidderminster; and in hedge rows, Chaddesley Corbet, &c.; T. P.

* **Geum rivale.** Abberley; Hickman.

Sorbus (*Pyrus*) Aucuparia. Near Bromsgrove Lickey, abundantly; T. P.

* **Parnassia palustris.** Feckenham Moors; T. P.

* **Carduus acaulis.** Defford Common, between Pershore and Upton-on-Severn, abundantly; T. P.
* **Erigeron acre.** Sherrif's Lench; Rufford.
* **Campanula latifolia.** Dick Brook foot bridge, near Stourport; Mrs. Gardner. Lincoln Wood; Hickman.
* **C. patula.** Glasshampton; Hickman. Hartlebury; Mrs. Gardner.

Pyrola media. Cradley Park, near Stourbridge; Scott.

* **Chironia** *(Erythræa)* **Centaurium.** Flore albo. Near Dudley, Worcestershire; Bree.
* **Gentiana Amarella.** Woodbury Hill; Mrs. Gardner.
* **Menyanthes trifoliata.** Wilden; Hanley Common; Hickman.
* **Antirrhinum Orontium.** Lower Areley, near Bewdley; Mrs. Gardner.

Linaria minor. Broadway Hills; Rufford.

Lathræa squamaria. Abberley; Mrs. Gardner.

Scutellaria minor. Hanley Common; Hickman.

* **Lysimachia vulgaris.** Hampstall; Mrs. Gardner.
* **Butomus umbellatus.** Between Stourport Bridge and Lickhill; Mrs. Gardner.

Orchis ustulata. Abberley; Mrs. Gardner.

* **Ophrys apifera.** Abberley; Mrs. Gardner. Eastham, near Tenbury; Rev. Mr. Whitehead.
* **Serapias** (*Cephalanthera*) **ensifolia.** Abberley Hill; Mrs. Gardner.
* **Galanthus nivalis.** Astley Wood, near Stourport; Hickman.
* **Convallaria majalis.** Abundantly in Shrawley Woods; Hickman.

Of the 37 plants in this list, the following ten are new records:—

Helleborus fœtidus Mrs. Gardner. Mr. Hickman.
Thlaspi arvense. Hickman.

Euonymus europæus. Scott.	**Linaria minor.** Rufford.
Rubus Idæus. T. Purton.	**Lathræa squamaria.** Mrs. Gardner.
Pyrus Aucuparia. T. Purton.	**Scutellaria minor.** Hickman.
Pyrola media. Scott.	**Orchis ustulata.** Mrs. Gardner.

Thlaspi arvense and Scutellaria minor take precedence of Perry's records, 1831; Euonymus europæus, Rubus Idæus, and Pyrola media are earlier records by Scott than those in the "History of Stourbridge," 1832; Pyrus Aucuparia and Lathræa squamaria take precedence of Edwin Lees's records in London, 1830; Orchis ustulata takes precedence of the record in Mary Southall's Description of Malvern, 1825.

The late Mr. Edwin Lees in the introductory remarks to his catalogue of Worcestershire plants, contributed to the "Illustrations of the Natural History of Worcestershire," by the late Mr. Charles Hastings, M.D. (1834), to be described hereafter, has given a list of the principal works in which notices of Worcestershire plants were to be found up to that date. Those which have not been already referred to in these pages are the following:—

Laird's Topography of Worcestershire in the "Beauties of England and Wales."

"Walford's Scientific Tourist through Great Britain."
Florence's "Worcester Guide."
Dr. Booker's "History of Dudley."
"The Midland Medical and Surgical Reporter."
No dates are given to any of these works.

The account of Worcestershire, by F. C. Laird, is contained in Vol. XV. of the "Beauties of England and Wales," 1814. It contains three lists of plants: those of the neighbourhood of Malvern, at p. 822; of the neighbourhood of Pershore, at p. 859; of Bredon Hill, at p. 865. With the exception of Clematis Vitalba, previously noted by Pitt, all the species are taken, without acknowledgment, from the first catalogue of Dr. Nash.

I have not seen Walford's "Scientific Tourist through Great Britain." I am indebted to my friend, Mr. F. E. Blackstone, of the British Museum, for a description of it, and for extracting the list of Worcester plants. The work was published, in two vols., in 1818. The Worcester list comes last in Vol. I. It contains 41 "rare plants," most of them discovered by Nash, Stokes, or Withering, and was probably taken from one of the later editions of the "Botanical Arrangement" of the latter author. It contains no original matter and no new records.

"A Descriptive and Historical Account of Dudley Castle and its surrounding scenery," by the Rev. Luke Booker, LL.D., vicar of Dudley, was published at Dudley in 1825. It contains, at p. 107, "A List of Plants, &c., growing (many of them indigenously) near the Castle," and is interesting as the first collected record of the plants of the Castle Hill. I therefore give the list entire, re-arranged in accordance with modern sequence:—

Anemone nemorosa.
* **Reseda Luteola.**
Linum catharticum.
Geranium dissectum.
* **G. (*Erodium*) moschatum.**
Alchemilla vulgaris.
Rosa villosa.
R. canina.
R. arvensis.
Cratægus Oxyacantha.
Pimpinella Saxifraga.
* **Carduus eriophorus.**
* **Conyza squarrosa.**
* **Erigeron acre.**
Fraxinus excelsior.
* **Chlora perfoliata.**
* **Solanum Dulcamara.**
* **Atropa Belladonna.**
* **Thymus Serpyllum.**
* **Melissa Calamintha.**
* **Echium vulgare.**
Plantago media (var. *foliosa*).
* **Ulmus campestris.** ⎫
U. suberosa. ⎬ *One species.*
U. glabra. ⎭
U. montana.
* **Paris quadrifolia.**
* **Colchicum autumnale.**
Avena elatior.

Of the 27 plants in the above list, 13 are new records. Two of them, viz., Alchemilla vulgaris and Rosa villosa, take precedence of the records in Mr. Edwin Lees's list of Malvern plants in "Loudon's Magazine;" and three of them, viz., Linum catharticum, Plantago media, and Avena elatior take precedence of the same plants in Scott.

(To be continued.)

TWENTY-NINTH ANNUAL REPORT

OF THE

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY,

PRESENTED BY THE COUNCIL TO THE ANNUAL MEETING, FEBRUARY 1ST, 1888.

The Society has worked during the past year, 1887, under the new arrangement of sections, the four sections—Microscopical, Biological, Geological, and Sociological—meeting on the four successive Tuesdays in each month, and this arrangement has been found satisfactory and successful. The particulars of the papers read at the meetings are given under the heads of the different sections, and several of these papers have been of much interest and value, and have well sustained the character of the Society.

A conversazione was held on October 4th, at the opening of the session, and proved very successful. It was held in the Examination Hall, Mason College, and a fine collection of zoological, botanical, and geological specimens was contributed from the College Museums. An interesting collection of birds and their nests was exhibited by Mr. Chase ; a large collection of fungi by Mr. Grove ; and an extensive series of glass photographs by Mr. Pumphrey and Mr. Watson ; also a number of objects under microscopes. The conversazione gave great satisfaction, and from the liberality of friends the cost to the Society was very small.

An excursion to Oxford was carried out on Whit Monday, when the members were very kindly received by Mr. Druce and Mr. Simms and the several College authorities, and had a very interesting and agreeable review of the college buildings and gardens, and of the Botanic Gardens, over which the members were conducted by Professor Balfour.

The annual meeting of the Midland Union of Natural History Societies was held at Malvern, on July 6th and 7th, where excursions were made to the Syenitic Quarries of the North Hill, the Upper Llandovery Sandstone at the Wyche, the British Camp, and Ledbury Church ; and the fine Silurian and Old Red collection of Mr. G. H. Piper was seen.

The annual financial statement of the treasurer shows the total receipts for the year, £249 2s. 11½d., the total payments (including adverse balance of £17 19s. 1½d. last year), £251 0s. 5½d., leaving a balance due to the treasurer of £1 17s. 6d. The receipts for the year from subscriptions have covered the current expenditure of the year, showing that the Society is in a sound working position; but there was, at the commencement of the year, a considerable amount of arrears owing for rent and for publication of proceedings, as well as the balance due to the treasurer, and for the purpose of clearing off these arrears six loans of £10 each have been granted by some members of council, and after paying all accounts due at the end of the year, the two sides of the account are now practically balanced.

The council have provided for paying off these loans by effecting a reduction in the expenditure, dispensing with the assistant curator and librarian, and discontinuing for the present the daily opening of the Society's room, by discontinuing expenditure upon the library, and suspending the supply of the expensive serial publications. It has been with great reluctance and regret that the council have taken this step, but they felt bound not to let the Society remain in debt, and not to incur any current expenditure that could possibly be avoided until that object is accomplished. They look with confidence to the speedy restoration of these temporary suspensions, and they appeal earnestly to the members to assist in hastening that time by obtaining additions to the number of members, and so increasing the income of the Society.

The total number of members for the year 1887 is 208, being 7 less than the previous year. There are 7 life members, 152 ordinary (guinea) members, 13 family (half-guinea) members, 5 honorary vice-presidents, 27 corresponding members, and 4 associates.

The council have deep regret in recording the loss, during the year, of Mr. Thomas Bolton, F.R.M.S., whose lamented death has been widely felt. He was for many years a very active and valued member of the Society, and has been of late years acting as the assistant curator and librarian. Shortly before his death, a wish was expressed that his services to the Society should be recognised by making him a life member, but, his death intervening, this distinction has been conferred instead upon his son, Mr. Thomas E. Bolton.

A fine set of microscopical slides of polycystina and diatomaceæ, from the celebrated Barbados earth, has been presented to the Society by Professor Hamilton, of the Government Laboratory, Barbados. A cabinet for 1,000

microscopical slides has been presented to the Society by Mr. William Morley, as a memorial of his late brother, Mr. John Morley, who was for so many years the active honorary secretary of the Society.

An important question that has been recently occupying the attention of the council is a proposal for amalgamation of this Society with the Birmingham Philosophical Society. This has been discussed by a joint committee of the two Societies, and is still under the consideration of the respective councils.

Microscopical Section (*Ex-officio:* President, Prof. W. Hillhouse, M.A., F.L.S.; Secretary, W. H. Wilkinson).—During the year nine meetings of the section have been held, with an average attendance of fifteen; and the following communications have been made:—

March 1st.—Measurement of magnifying power of microscopic objectives, with exhibition of his new $\frac{1}{25}$in. objective: W. P. Marshall, M.I.C.E.

April 5th.—Colour-reaction, its use to the microscopist and to the biologist, with experiments: W. H. Wilkinson.

May 3rd.—The anatomy of rotifers, illustrated by living specimens and coloured drawings: T. Bolton, F.R.M.S.

June 7th.—Devitrification of volcanic glasses, with specimens and sections: T. H. Waller, B.A., B.Sc.

November 1st.—Photo-micrography, with practical illustrations: J. Edmonds.

Mr. W. P. Marshall showed his new $\frac{1}{25}$in. objective at two meetings of the section, showing how to work with powers of such high magnification, and affording the members the opportunity of seeing any of their own specimens under higher powers than are usually accessible; Mr. W. B. Grove exhibited fungi preserved by the process of Mr. English, by plaster of Paris, and a preservative solution; Mr. T. Bolton exhibited a number of specimens of minute fresh-water life, especially rotifers, many of which were rare, and some new to science; Mr. Horace Pearce exhibited a collection of rocks from the Lake district; and Mr. W. H. Wilkinson, a number of lichens and plants.

Biological Section (President, R. W. Chase; Secretary, W. P. Marshall).—During the year eleven meetings of the section were held, with an average attendance of seventeen members, and the following papers have been read at the meetings:—

February 8th.—South American and European mosses, with micro-preparations: J. E. Bagnall, A.L.S.

March 8th.—Micro-fungi, illustrated by coloured lantern slides: Rev. H. Friend, F.L.S.

April 15th.—Phosphorescence in the animal kingdom: A. B. Badger.

May 10th.—Third eye in *Anguis fragilis*, the slow-worm: H. J. Carter, F.R.S.
June 14th.—Investigations into the function of tannin in the vegetable kingdom: Professor Hillhouse, M.A., F.L.S.
July 12th.—British plants now growing in his "Wild Garden" at Shrewsbury: Horace Pearce, F.L.S., F.G.S.
October 11th.—Dredging excursion to Puffin Island at the recent British Association meeting: W. P. Marshall, M.I.C.E.
December 13th.—*Hyalonema lusitanicum*, the glass-rope sponge: W. R. Hughes, F.L.S.

Three supplementary meetings have also been held for the "Study of Mosses and their Life History," conducted by Professor Hillhouse and Mr. Bagnall; and it is desirable for such a proceeding to be carried out in other branches of biology.

Extensive collections of fungi, including several new species, have been exhibited by Mr. Grove; numerous specimens of mosses and lichens by Mr. Bagnall and Mr. Wilkinson; and a fine series of diagrams, illustrating the structure of sponges, was exhibited by Mr. Hughes. An improvement in the new surface tow-net, used in the former Tenby excursion, was exhibited in connection with the paper on the "Puffin Island Excursion."

Geological Section (President, T. H. Waller, B.A., B.Sc.; Secretary, J. Udall, F.G.S.)—Ten meetings of this section have been held during the year, with an average attendance of eighteen members. The section is pleased to acknowledge its continued obligations to the chairman for several valuable papers during the session, and the exhibition of many rock sections, and experiments in illustration of his papers. Special mention should also be made of the valuable aid rendered be Mr. C. Pumphrey in illustrating various papers by the oxy-hydrogen lantern. The following communications were made to the section:—

February 22nd.—Photographic Views in Switzerland (taken during a holiday tour by Mr. C. J. Watson), were shown with oxy-hydrogen lantern, by Mr. C. Pumphrey. Mr. C. J. Watson described each view as it was projected on the screen.
March 15th.—Paper by Professor Hillhouse: "On the Distribution of Plants in Time."
April 19th.—Note on "Occurrence of Gold at Mount Morgan, near Rockhampton, Queensland," by Mr. John H. Lloyd, M.A.
A paper by Mr. A. H. Cocks on "Chillingham Wild Cattle."
May 19th.—Paper by Mr. W. P. Marshall on "The recent Riviera Earthquake," with particulars from eye-witnesses. At the close of the paper, Mr. Evans (a visitor introduced by Mr. Walliker), who was present at Mentone during the earthquake, gave a graphic and dramatic account of his experience of the earthquake and its effects.
July 19th.—Note by Mr. Waller on the "Remarkable and Unique Geology of Skye and the surrounding district."
August 16th.—Note by Mr. Horace Pearce, F.G.S., on "Silver-bearing Rocks from the Rocky Mountains."

October 18th.—Paper by Mr. Waller on "The Micro-chemical Methods for the Examination of Minerals," illustrated by (1) Experiments in Flame-colouration; (2) Solutions of Minerals placed under microscope.

November 15th.—Paper by Mr. W. Pumphrey on "The recent Disaster on Lake Zug," illustrated by photograph and ground plan.

Sociological Section (President, W. R. Hughes, F.L.S.; Secretary, F. J. Cullis, F.G.S.).—The work of the section has been steadily maintained throughout the year, a total of twenty-five meetings having been held; ten of which were ordinary meetings, thirteen supplementary meetings, and two excursions; the average attendance being twelve. At the October meeting, the President delivered his address on the Recent Literature of Evolution. The other meetings were devoted to the study of Mr. Herbert Spencer's "Data of Ethics," papers being read as follows:—

February 22nd.—Introductory Paper, by Miss Naden.

March 22nd.—On the Evolution of Conduct: Mr. F. J. Cullis.

April 26th.—On the Physical and Biological Views of Conduct: Mr. W. R. Hughes.

May 24th.—On the Psychological and Sociological Views of Conduct: Mr. W. R. Hughes.

June 28th.—Criticisms and General Review: Mr. A. Browett.

November 22nd.—On the Relativity of Pains and Pleasures: Mr. W. B. Grove, B.A.

The supplementary meetings were held on the first and third Thursdays of the months, tea being served at 5.30, after which the following papers were read:—

March 3rd.—On Mr. Herbert Spencer's "Factors of Organic Evolution:" Mr. A. Browett.

March 17th.—On Ditto, ditto, ditto: Mr. A. Browett.

April 7th.—On Ditto, ditto, ditto: Miss Byett.

April 21st.—On Ditto, ditto, ditto: Mr. F. J. Cullis.

May 5th.—On "Complexion in relation to Offspring:" Mr. W. H. France.

May 19th.—On Mr. Herbert Spencer's essay on "Use and Beauty:" Mrs. Browett.

June 2nd.—On Mr. Herbert Spencer's essay on "Manners and Fashion:" Miss Dalton.

June 16th.—On Individualism in Art: Mr. W. K. Parkes.

June 30th.—On Mr. Herbert Spencer's essay on "Manners and Fashion:" Miss Dalton.

November 3rd.—On Mr. Herbert Spencer's essay on "The Classification of the Sciences:" Mr. F. J. Cullis.

November 17th.—On Ditto, ditto, ditto: Mr. F. J. Cullis.

December 1st.—On Mr. Herbert Spencer's essay on "The Philosophy of Style:" Miss Dalton.

December 15th.—On Mr. Herbert Spencer's essay on "The Genesis of Science:" Mr. W. K. Parkes.

On Saturday, July 23rd, the members and friends of the section made their ninth excursion, this being to Hartshill, as "Michael Drayton's Country." After a pleasant ramble, Dr. Showell Rogers read a very able paper on "Michael

Drayton and his Works." The tenth excursion of the section was made on December 17th, this being confined to places in Birmingham—as "Dr. Priestley's Country." There was afterwards exhibited in the Society's room, through the kindness of Sam: Timmins, Esq., F.R.S.L., and Mr. W. H. Cope, a large and interesting collection of Dr. Priestley's books, engravings, and autograph letters. A sympathetic and eloquent address on "Priestley" was also delivered by Dr. Crosskey, the able and courteous successor to his pulpit.

Miss Naden's introduction to the study of the "Data of Ethics" and Mr. W. K. Parkes's essay on "Individualism in Art" have been published in the "Midland Naturalist." The section has suffered a great loss in the removal of Miss Naden from Birmingham.

The Library.—The librarian (J. E. Bagnall, A.L.S.) reports favourably as to the state of the Library. The issue of books has been as follows: Botany, 52; Zoology, 22; Ornithology, 5; Entomology, 8; Geology, 20; Microscopy. 20; Philosophy and General, 59; total, 181, being 36 in excess of last year. The number of persons borrowing books during the year has been 38, as against 41 in the previous year. The list of books added to the Library during the year will be separately published.

General Property.—The curators (G. M. Iliff and H. Miller) have to report that the microscopes are now in good order, the necessary repairs having been effected during the year. The parabolic illuminator belonging to the Swift microscope, mentioned as missing in the last year's report, has been found and replaced in its case.

NOTES ON THE WARWICKSHIRE STOUR VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 38.)

The River Stour and its Affluents.

The Stour rises at Stour Well, near Tadmarton Camp, in Oxfordshire, and enters Warwickshire at Traitor's Ford, three miles west of its source. Here it is a rapid but insignificant stream, and its course is west and north-west, through Stourton and Cherrington to Mitford Bridge, receiving small feeders on right and left bank, near Whichford Mill; on its right bank at Stourton it joins, or, better, takes the bed of Sutton Brook, a stream rising near Compton Wynyates, and flowing through Lower Brailes and Sutton-under-Brailes.

At Mitford Bridge it is fed by another tributary, Nethercote Brook, which stream rises on the west slopes of the Oxfordshire boundary, about a mile south of Traitor's Ford, and at an elevation of 420 feet. It is fed by numerous streams rising on the slopes of Bright Hill, and has. for some distance, a course nearly parallel with the Stour. Its course is west for about four miles, through Long Compton and north of Barton-on-the-Heath; here it is joined by Stamford Brook, and its course becomes northerly for about three miles to Mitford Bridge, joining the Stour on its left bank, having received near this a stream from Wolford Wood and the surrounding district. The Stour now flows northward by Burmington Mill; near this place joined by Knee Brook, which rises on the eastern slopes of Ebbrington and Knowlands Hill, and drains a wide extent of country; and a little further north a small stream from Brailes Hill enters the Stour at its right bank.

From this point the Stour flows north through Barcheston, Shipston-on-Stour, Honington Park, and Tredington. Here it receives, on its right bank, another important tributary. This stream is formed by a confluence of streams. the main one rising at Brome Hill, at an elevation of about 700 feet, about three miles north of Traitor's Ford. This flows north-west by Tysoe, through Oxhill, where it is augmented by a small feeder rising on Tysoe Hill; the united streams flowing on to Whatcote Bridge, where they are further augmented by a stream rising at Compton Wynyates. The united stream flows west towards Halford, and taking a sudden turn south, flows into the Stour near Tredington Mill, where the river bed has an elevation of about 180 feet, the whole course being about nine miles. About this part of the district the country lies low, and floods are not unfrequent in rainy seasons.

The Stour continues a north-west course by Halford Bridge, through Lower Eatington Park and Upthorpe to Wimpstone; here it receives a small feeder, Humber Brook, rising on the northern slopes of Ilmington Hill. From this point it passes through the beautiful park at Preston-on-Stour, through Atherstone-on-Stour and Clifford Chambers, to its confluence with the Avon near Milecote. Its total course is about nineteen miles, its fall being from 365 feet at Traitor's Ford to 110 feet at its confluence with the Avon.

In endeavouring to give some account of what has been recorded from this district, it is scarcely needful that I should state that most of the plants I shall mention have been found and recorded by Mr. Newbould, others by the Rev. James Gorle, of Whatcote, and some by F. Townsend, Esq., of

Honington Hall. I have felt it would be tedious to be constantly mentioning these names in connection with the plants I notice. I have invariably given each of my kind correspondents the full credit of their work in my "Flora of Warwickshire," which I am hoping shortly to publish.

The whole district of the Stour is well-wooded. This not only gives a special charm to the district, but as the hedge-row trees are frequently clothed with abundant mosses, scale mosses, and lichens, the eyes and mind are kept fully occupied looking for these minuter treasures, rendering a walk through this district one of never-failing interest. The ash and elm are abundant, and from these I have gathered rich harvests of cryptogamic wealth, such as *Orthotrichum obtusifolium*, which occurs at Tysoe, Brailes, and Ilmington. *O. tenellum* and *O. stramineum*, which occur at Wimpstone. *Cryphæa heteromalla*, a rare plant usually in Warwickshire, is frequent in this valley. *Tortula lævipila*, *T. papillosa*, and *T. latifolia* are not unfrequent, the two latter being in abundance at Wimpstone. *Zygodon viridissimus*, *Leucodon sciuroides*, and *Orthotrichum affine* are abundant. *Anomodon viticulosum* occurs at Wimpstone. *Weissia cirrhata*, usually frequent in the county, is rare in this valley, but I have it from Ilmington. Of Hepatics, I have found few that were more than local. *Radula complanata*, *Porella platycarpa*, and *Aneura sinuata* occur, but the most constant species is the common *Frullania dilatata*.

Spinneys, coppices, and small woods are frequent, but are somewhat disappointing. In one at Ilmington, however, I noticed abundance of *Equisetum maximum*. In Honington Park *Vinca minor* is quite established and abundant, and near Pillerton Lazer, which is the extreme northern limit of the district, I noticed *Epipactis latifolia* and *Listera ovata*. But there are also large woods, such as those at Whichford, Long Compton, Weston, Barton-on-the-Heath, and Great and Little Wolford. Each of these I have visited, but in many cases too hurriedly to form any opinion as to their flora. A wood requires close investigation, plenty of time, and permission to roam at will through all parts. The woods here are usually closely preserved, and are often very difficult of access, hence my records from these haunts of our wild flowers will be poor. *Stellaria umbrosa* occurs near Great Wolford, *Dipsacus pilosus* and *Arctium nemorosum* were pointed out at Honington, *Primula caulescens* and *P. intermedia* being also recorded from the same locality. *Rubus idæus*, rare in this district, I noticed near Brome Hill and Tysoe; *Lysimachia Nummularia* at Wimpstone, and *Lithospermum officinale* from Lower Eating-

ton. Ferns are remarkably rare in this valley. I have, however, seen *Lastrea filix-mas* var. *Borreri*, *L. spinulosa*, *L. dilatata*, *Athyrium filix-fœmina*, and the fine variety *rhæticum* at Great Wolford and Barton-on-the-Heath. Of woodland mosses, the more rare are *Hypnum brevirostre*, *H. piliferum*, *H. striatum*, *Orthotrichum Lyellii* in fruit, *Polytrichum attenuatum*, *Pogonatum aloides*, and *Scapania nemorosa*, all from Wolford Wood.

Fields and pastures are always inviting, and few districts are more convenient to the botanist for a thorough exploration of these places than this Stour Valley, for here bridle roads and footways are a prevailing feature. Little that is really rare has at present been noticed, but of the more noteworthy the following may be mentioned:—*Papaver lecoqii*, *Senebiera coronopus*, *Lychnis segetum*, and *Saxifraga granulata* are all recorded from near Honington. All these are rare in the district:—*Valerianella dentata*, *Picris hieracioides*, *P. echioides*, *Linaria spuria*, *L. elatine*, *L. viscida*, *Galeopsis ladanum*, *G. speciosa*, *Chenopodium polyspermum*, and *Orchis morio* were also all found near Honington, Lambcote, and Halford, but I have not seen them elsewhere in this valley. *Brassica nigra* and *B. alba* occur near Great Wolford. *Thlaspi arvense*, usually abundant in Lias soils, occurred as a single specimen at Wimpstone. *Rhaphanus rhaphanistrum* was very abundant at Tysoe, and here, also, I saw for the first time *Chrysanthemum segetum*. *Alchemilla vulgaris* I have not seen, but Mr. Gorle records it from Idlicote; and the rare *Spiræa filipendula* is recorded by Mr. Townsend from Armscote, one of the few places in this district that I have not seen.

The roads and lanes of a district are often specially interesting, and not unfrequently afford the botanist a better idea of what has been the prevailing flora of the district than he could gain from either woods, pastures, or fields. They are always of special interest to me, for it was in the lanes I took my first lessons in botany, and often still I linger by the banks redolent of violets, or bright with cheery speedwell, and look with the same old enthusiasm for the first primrose, or search the neglected wayside, among wavy ranks of poa and fescue and dogstail, or squat plantain, and sand-wort for some rarer and more prized weed. But in this district the wayside flora is poor, and mile after mile may be travelled with only an ever-recurring repetition of the same plants; whilst I do not remember to have found more than one or two of the rarer plants, I have found several that are local in other parts of the county. *Ranunculus auricomus*, and *Viola Reichenbachiana*, *V. hirta*, and *V. odorata* occur about Great Wolford, Honing-

ton, Idlicote, and Eatington. *Malva rotundifolia*, Shipston-on-Stour and Honington. *M. moschata* is not unfrequent. *Hypericum hirsutum* is widely spread, but *H. pulchrum* I have only seen growing with *Senecio sylvaticus*, *Hieracium boreale*, and *Aira flexuosa* on Compton Warren, near Tysoe. *Geranium pyrenaicum* occurs as a casual near Honington. *G. pratense* and *Melilotus officinalis* are frequent, whilst *M. arvensis* is merely a casual at Tysoe and Oxhill. *Trifolium medium*, *T. striatum*, and *T. filiforme* are recorded from Honington only. *T. hybridum* is occasional on field borders, a mere remains. *Anthyllis vulneraria* and the pretty *T. fragiferum* occur at Eatington, Honington, and Whatcote, but *Lathyrus nissolia* is only recorded from Honington, and I have only once seen *L. machrorrhizus*, near Great Wolford. *Conium maculatum*, *Sison amomum*, *Silaus pratensis*, and *Centaurea scabiosa* are somewhat frequent. *Carum segetum* and *Adoxa moschatellina* I have not seen; both are recorded from Honington. *Galium mollugo* I have seen at Halford and Wolford. *Carlina vulgaris* on some moorish land near Wimpstone. *Serratula tinctoria* near Brailes. *Inula conyza* at Atherstone-on-Stour and Whatcote. *Arctium majus* Honington and Brailes. *Carduus nutans* Compton Warren, Tysoe, and Wimpstone. *C. eriophorus* on Bright Hill. *Taraxacum erythrospermum* near Ilmington, whilst *Carduus crispus* and the rayed form of *Centaurea nigra* are not unfrequent. *Lamium galeobdolon*, frequent in North Warwickshire, is rare here; I have only seen it at Barton-on-the-Heath. *Nepeta Cataria* at Lambcote and Atherstone-on-Stour. *Bromus erectus* and *Brachypodium pinnatum* at Eatington and Barton-on-the-Heath. *Orchis incarnata* and *O. latifolia* Mr. Newbould showed me from marshy land near Halford. *Avena pratensis* and *Verbena officinalis* occur at Tredington, just over the county boundary; and *Blackstonia perfoliata* is recorded by Mr. Townsend from near Admington.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 40.)

Control over the Purity.—The first and most persistent opposition to this scheme of water supply arose from the idea that the water might be made impure by the construction of similar dumb-wells for the disposition of sewage or other objectionable matter, as there was no legal control over

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underground waters. It was pointed out that an outlying district of Northampton—St. James' End—at that time in considerable difficulty as to the disposal of its sewage, might construct dumb-wells, reaching to the Marlstone, and get rid of it by means of them, and thus contaminate the water supply of the town. As it was then generally thought there was no legal power to prevent this, I could only answer such objections by pointing out that it was not probable the authorities at St. James' End would try a scheme which it was impossible could work satisfactorily for them; for one such well would rapidly silt up, with the solid matter carried into it, to above the water-bearing bed, and then not even the liquid portion would be got rid of. Fortunately there is now little fear that such a plan will be tried here or elsewhere in the country, for it has been decided in a very emphatic manner that although the owner of a well has a perfect right to all the water he can obtain from it, as it exists in nature, he must not deny that right to others by polluting the common source. The case is so important that it cannot be too well known; hence I have given a summary of the contention and decision below.

*About forty years ago two deep wells, with borings, were made at Brentford, one at a brewery, the other at a distillery. They both passed through Gravel, London Clay, and the Lower London Tertiaries into the Chalk, the last named being met with at a depth of rather over 300ft. The two wells are 99yds. apart, and when the distillery ceased to exist, and the premises were converted into printing works, the well there was used as a cess-pit, with the result that the other well became considerably contaminated, and of course continued to be so when the disuse of the first named well was stopped. This condition of matters led to an action by Mr. Ballard against the owner of the distillery well, Mr. Tomlinson, for heavy damages. There was absolute proof of communication between the two wells, and so the decision for defendant given by Mr. Justice Pearson, in February, 1884, was entirely based on his interpretation of the law, he holding that the plaintiff had no greater right with respect to the quality of the water than he had with regard to the quantity, that he must take the water as he found it, both in quantity and quality, the decision

* From a pamphlet by Mr. W. Whitaker, B.A., F.G.S., &c., on "A recent Legal Decision of importance in connection with Water Supply from Wells." Report of paper read September 25, 1885, at Congress of the Sanitary Institute of Great Britain. See also "Justice of the Peace" for February 21, 1885.

being based upon a well-known case, "Chasemere v. Richards." The case was then taken to the Court of Appeal, and the previous decision unanimously overruled by the Master of the Rolls and Lords Justices Cotton and Lindley, in February, 1885. The reasons assigned for this were to the effect that an owner of property has no ownership over the water percolating below the surface of the ground, though he has a right to appropriate as much as he likes during its passage under his land, even to the extent of taking it all, but he must not pollute the common reservoir or source so as to affect the right of his neighbours to appropriate the water in its natural state. In answer to an argument on behalf of defendant to the effect that if the plaintiff had not by artificial means pumped up the water he would not have sustained damage, so that the damage would not have accrued but for his own act, it was replied that "as long as a person did not use means which were unlawful, however artificial or extensive those means might be, he had a right to use them."

It must be a great relief to authorities deriving their water supply from underground sources of moderate depth to know that they can stop pollution of the reservoir, even though the source of the pollution may be a considerable distance away, and particularly in cases where the porous bed is of considerable thickness, and so would not easily bring about its own prohibition of disuse by silting up.

THE PURIFICATION OF WATER.

There is so much difference of opinion with respect to what constitutes a safe water for drinking purposes, and as to the adequacy of natural and artificial means of purification, that I venture to submit the following notes on the subject, and then the sufficiency or otherwise of the precautions suggested in connection with the filling up of the Marlstone may be judged.

The impurities in a water may be derived from the atmosphere through which it passes as rain, the soil through or over which it runs, the rocks or deposits in which it is collected, and the sewage or other matter discharged into it,

Rain Water, which indeed all fresh water is in the first instance, has had less opportunity of becoming polluted than any other water; but even this is seldom satisfactory for drinking purposes unless collected far away from towns. Analysis of samples of rain from various parts of the country, made for the Rivers Pollution Commission, show that it is water that has washed a *dirty atmosphere*, full of the products of respiration of animal life, and of animal and vegetable

waste and decay, and zymotic germs, together with the fumes of manufacturing processes. These various substances hang suspended in the air, and may be carried long distances by the wind until condensation of moisture takes place, and then they are entangled in the minute globules of water forming clouds, and are so brought down with the rain.

Half-a-pint of rain water often condenses out of 3,873 cubic feet of air, the quantity of air a man would breathe in eight days, so that in drinking that quantity he swallows an amount of impurity that would only reach his lungs from the air in eight days.*

However unsuited ordinary rain water may be for drinking, it is very valuable for washing, owing to its softness, and therefore the small amount of soap required for detergent purposes compared with that required by hard waters.

If then rain water is so impure, and at the first contact with the ground it usually becomes much more so, it is evident that some highly-efficient purifying processes are at work to enable us to have any water to which the term pure may be applied. By carefully considering the way in which alone this purification is accomplished naturally, viz., by oxidation and filtration during the passage of the water through soil and rock, and the amount of it which around Northampton gives a reputedly pure spring water, the efficiency of the various arrangements proposed for filling up the Marlstone will be very evident.

A Pure Water is never met with naturally, but a water is usually regarded as pure that is free from all those substances that can be injurious to persons drinking it. It may contain impurities that are objectionable for other household, or for manufacturing purposes, some of which may and others may not be removed by artificial processes, save that of distillation.

Hard and Soft Waters.—Of good waters, some are hard and some soft, *i.e.*, some destroy much soap in the process of washing, others little; and the hardness may be temporary or permanent.

Temporary hardness is due to the presence of the carbonates of lime or magnesia in the water. Perfectly pure water will not dissolve much of these substances, only about two grains to the gallon (70,000 grains) of the most common one of the two—carbonate of lime; but water containing carbonic acid, as all rain and most other water does, will dissolve more of these carbonates in proportion to the amount of acid (carbonic

* Sixth Report of Rivers Pollution Commission.

acid gas dissolved in water) present. The soluble substance formed by the action of carbonic acid on a carbonate is usually called a bicarbonate. On boiling the water, any carbonic acid gas present is slowly driven off, and the carbonates of lime or magnesia previously dissolved by it thrown down as a precipitate—the fur of the tea kettle, and the incrustation of the steam boiler—and the water is to that extent softened; hence the term "*temporary*" to hardness arising from the presence of carbonates. A process adopted on a larger scale for softening water is that known as Clark's process; it is carried out by adding a sufficient amount of lime to the water to take up all the carbonic acid gas present. The two substances form carbonate of lime, which is thrown down, together with the carbonates previously dissolved by aid of the carbonic acid now otherwise engaged.

Permanent hardness is due chiefly to the presence of the sulphates of lime and magnesia in water, and in this case also it is the lime salt that is most commonly present. There being no workable process for removing the sulphates from water, the hardness arising from their presence is termed *permanent*. Chloride of calcium may sometimes contribute to the permanent hardness.

The total solid residue obtained on evaporating a water may be made up of a number of substances, only part of which give to water the property of hardness. The others may or may not indirectly contribute to the hardness, or be injurious themselves.

The question of hardness and total solids deserves some little consideration, because the Marlstone water is certainly rather hard, and that previously supplied to the town always contained about fifty grains of solid matter per gallon, an amount which it is usually considered should not be exceeded in a good drinking water.* From my own observations I have no doubt that the water was good and wholesome, and not injurious to the public health, though one or two instances came under my notice where the water appeared to produce some derangement of the digestion with persons using it, for the symptoms ceased when they boiled the water before drinking. The general opinion appears to be that within considerable limits there is no difference between hard and soft waters as regards health, and that habit has a great deal to do with the matter; a change from one kind of water to

* For a considerable amount of evidence on this and other similar matters by Doctors Frankland, Lyon Playfair, Parkes, Miller, &c., see "National Water Supply," a pamphlet published by the Society of Arts in 1878.

another may cause derangement whichever way the change is made, from hard to soft or soft to hard. Dr. Parkes thinks that the permanent hardness is of more consequence than the temporary, and that calcic sulphate, magnesic sulphate, and calcic chloride disagree in smaller amounts than carbonate of lime, also that less than ten degrees of permanent hardness may be injurious to some persons.

Hard water is supposed to give to horses a staring and rough coat, and grooms avoid the use of it as much as possible. This would seem to indicate some derangement of the system brought about by the hard water.

It is thought that a hard water keeps better than a soft one, and that it is less liable to absorb organic impurities, properties of less consequence where there is a constant supply than where the supply is intermittent.

(*To be continued.*)

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

IV.—FERNS.

FROM A LECTURE ON "BRITISH FERNS," 1875.

On the face of this remarkable planet there is no more remarkable plant than that which we English call the *Brake-Fern*, which the Scotch call *Bracken*, the Germans *Saumfarren*, the Italians *Felce feminina*, the Japanese *Warabi*, and the Russians *Wodianoi poporotnik*. Common and conspicuous in every quarter of the globe, it has perhaps a familiar name in a greater number of dialects than any other plant. But botanists all the world over know it by the one name of *Pteris aquilina*.

It is interesting for its beauty, clothing our heaths and hills with miniature forests, or standing in motionless armies, curled and crested, "shimmering in the shady wood-light," cool and green while the hot sun blazes in the summer sky. It is interesting also as the type of an order of plants remarkable for their structure, and still more for their history.

If we say that ferns have been growing in this world for ten million years, it is a very rough guess, and must be taken only as representing some vast unknown period to which all history is as one grain in a bushel of mustard seed. But in reading backwards the great inspired Stone-Book, the geological Bible, on nearly every page which speaks of vegetable life there is some record of the ancient family of ferns.

The earliest sedimentary rocks appear to have been deep marine deposits, in which no traces of land plants could be expected; but on reaching the Devonian beds we come upon swamp and shore formations, and here at once the fern-forms show themselves.

As to what the world was like before the Laurentian epoch we have as yet no knowledge. It may be that if ever the beds of existing oceans become inhabited continents, and the present continents the beds of future oceans, other sedimentary deposits will be brought to view still older than the oldest with which we are now acquainted, and will unfold to future explorers the secrets of the dawn of life for which we seek so eagerly and yet so fruitlessly. Or it may be that all those early strata have been melted by internal heat into the granites which seem to underly the fossiliferous strata everywhere, and that their priceless records have thus become unreadable and lost for ever. We only know that the earliest traces we have yet found of land vegetation are the remains of ferns and lycopods, and that there is reason to believe that out of some original variations in the development of some fern-forms, and by a succession of such variations, perhaps at long intervals, during the unknown ages of the past, there grew up gradually the arborescent ferns, the palms, the bamboos, the grasses, the rushes, and finally the beautiful flowering monocotyledons—lilies, irises, amaryllids, and orchids, and that out of some similar variations of the lycopod-form were gradually moulded the tall conifers or fir trees, the broad-leaved oaks, and poplars and sycamores, and at last those flowering dicotyledons, the roses, magnolias, laburnums, lilacs, and all the host which make the glory of our present summers.

But through all these changes the original types have been preserved even to this day. Some individuals may have varied widely, but in every generation some have come true to the leading features of the type. The lycopods of this age are clearly of one order with the lycopods of the coal, and the ferns which grow in our woods are, in essential points of structure, one with the ferns of all ages, though in non-essentials, in points which distinguish species and genera but not orders, the changes are marked and numerous.

At the present time there are known to botanists about 2,600 distinct species of existing ferns. The majority of these inhabit tropical regions and moist situations. Mountainous islands, shaded by woods and surrounded by warm seas and moist atmosphere, are the chosen homes of the fern family. Outside of the tropics the two islands in the northern and southern temperate zones which are richest in fern species for

their respective latitudes are New Zealand in the south and Great Britain in the north. New Zealand has 120 species and Great Britain 40; but the south temperate zone is everywhere richer than the north, in virtue of its more abundant moisture.

The whole of Europe contains only 60 species, and the whole of North America about 150. That Great Britain should have 40 shows therefore that for so small an area it is particularly rich. But then there is no other region in this latitude so warm and moist and hilly, and even within our narrow limits we see the influence of climate, for our damp and mountainous western coasts produce twice as many ferns as the dry flat eastern counties.

As with most cryptogamous plants nearly every species has a wide area of distribution. The brake-fern is absolutely cosmopolitan, The pretty bladder-fern, *Cystopteris fragilis*, is found in all temperate regions north and south, keeping to the high mountain tops within the tropics. Several of our British species besides the brake are found unaltered in New Zealand. Fifteen of our ferns are native also in the United States. One half of our 40 are found in the Himalaya Mountains, and the whole of them are European forms; we have not one which is exclusively British.

Wayside Notes.

THREE NOTED BOTANISTS have passed away during the past two months—Dickson, of Edinburgh; Anton de Bary, of Strasburg; and Asa Gray, of Harvard. We hope next month to give some brief account of their work.

THE VACANCY caused in the chair of "Botany and Medicine," at Edinburgh, by the death of Professor Dickson, has been filled by the election of Isaac Bayley Balfour, the Professor of Botany at Oxford. Professor Balfour's election is one upon the advisability of which botanists were pretty unanimous. He is himself the most distinguished botanist that Edinburgh has produced in recent times, and one of the ablest, if not the ablest, of the exponents of the new school of botany. His father, John Hutton Balfour, known far and wide as "woody fibre," preceded Professor Dickson in the same chair. At his resignation his son was candidate for the post, and it is currently reported that he only lost the succession by a single vote.

WE REGRET to see that Dr. Lapworth has not been elected to the chair of Geology at Oxford, vacated by Professor Prestwich. Professor Green, the successful candidate, is a distinguished member of the Geological Survey, and, with the Survey influence behind him, would probably have carried the election, even had he been a far less capable man than he is. Although the officials of the Survey have not scrupled to annex Dr. Lapworth's Highland discoveries, it is doubtful whether they have forgiven him for making them.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, January 31st, 1888, Mr. J. Levick in the chair; Mr. Herbert Stone and Mr. W. Kineton Parkes were elected members. Mr. J. E. Bagnall, A.L.S., exhibited for Mrs. Hopkins, a series of mounted preparations of birds' plumage to show peculiarities of wings, &c. Mr. W. B. Grove, B.A., exhibited a large specimen of the perfect hymenium of the "Dry-Rot," showing abundance of the tawny spores; and two other fungi, *Gymnosporium bambusæ*, and *Volutella stipitata*, all from Sutton; and a bottle of essence of beef, which had been liquefied by the growth therein of a bacterium.—Annual Meeting, February 7th. Professor Hillhouse, M.A., the retiring president, in the chair. There was a good attendance.—After some formal business, Mr. W. P. Marshall read the report of the council. Deep regret was expressed at the death of Mr. Thomas Bolton, F.R.M.S., the assistant curator and librarian of the society. The life membership, which was intended to be bestowed upon him, owing to his death intervening, had been conferred upon his son, Mr. Thomas E. Bolton.—Mr. C. Pumphrey, the retiring treasurer, made his financial statement, from which it appeared that the total amount of subscriptions received during the year was £190 9s. 6d., leaving a balance due to the treasurer of £1 17s. 6d.—Mr. W. R. Hughes moved a vote of thanks to Professor Hillhouse for his services as president during the past year, which was seconded by Mr. Levick, and carried.—Mr. W. B. Grove, B.A., was elected president for the ensuing year, on the motion of Professor Hillhouse, seconded by Mr. Rabone.—On the motion of Mr. Miller, Messrs. Charles Pumphrey, J. F. Goode, R. W. Chase, Lawson Tait, and A. W. Wills were elected vice-presidents for the year. Mr. Rabone was elected treasurer, and Mr. W. H. Wilkinson and Mr. W. P. Marshall joint secretaries. Mr. Pumphrey, having filled the office of treasurer for the long period of eighteen years, a special vote of thanks was accorded to him. The motion was ordered to be engrossed for presentation to Mr. Pumphrey. Mr. J. E. Bagnall, A.L.S., was elected librarian, and Messrs. Iliffe and Miller were re-elected curators and custodians of the property and instruments of the society. The six elective members of the council were Messrs. Alfred Browett, John Edmonds, James Heaton, H. J. Sayers, G. W. Tait, and Alfred Reading.—Biological Section, February 14th. Mr. R. W. Chase in the chair. Mr. R. W. Chase, F.L.S., was re-elected president of the section, and J. E. Bagnall, A.L.S., was elected secretary of the section. A vote of thanks was given to Mr. W. P. Marshall, M.I.C.E., for his services as secretary during the past year. Mr. J. E. Bagnall exhibited, with notes, the following plants: *Ceratophyllum demersum* in fruit from Liverpool, *Alisma Plantago* var. *lanceolata*, *Adoxa Moschatellina*, *Juncus Gerardi*, &c., from Warwickshire localities; for Mr. G. C. Druce, F.L.S., *Saxifraga rivularis*, *Juncus trifidus*, *Goodyera repens*, *Carex lagopina* and other rare plants from East Inverness; for Rev. D. C. O. Adams, fungi *Thelephora laciniata*, and *Polyporus abietinus* from Bournemouth; from the Marquis A. Botini, of Pisa, *Raphidostegium Welwitschii*, from near Pisa. Mr. W. B. Grove, B.A., exhibited, described, and illustrated with microscopical preparations, an interesting parasitical fungus from New Zealand, (with sections of the perithæca). *Cordyceps Robertsii*, which causes the caterpillar on which it grows to assume the appearance of being carved out of wood. Mr. J. Levick called attention to a paper on the flight of birds, on

which subject the president, Mr. R. W. Chase, made some instructive and interesting remarks. Mr. W. P. Marshall, M.I.C.E., read a paper on "The successful Use of Oil to Calm Rough Seas." This paper, which will shortly appear in the "Midland Naturalist," was full and exhaustive, and gave rise to an interesting discussion in which Messrs. Chase, Levick, Cullis, Wilkinson, and Grove took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—January 23rd. Mr. A. T. Evans showed pebbles from the Drift, and remarked on the frequency with which fossils occurred in zones; one pebble from the Bunter beds contained a *Lingula lescurii*; Mr. J. Madison, shells from Algiers, mostly Helices; Mr. J. Collins, a fungus, *Peridermium pini*.—January 30th. An exhibition, to which the public were invited, the President, Mr. T. H. Waller, B.A., B.Sc., in the chair. The exhibits were as follows:—Mr. H. Hawkes, a large series of mounted plants showing three forms of disease to which they were liable, viz., parasitic fungi, gall-making insects, and leaf-mining insects; Mr. P. T. Deakin, plants of the district, also a collection of nests and eggs; Mr. C. P. Neville, butterflies and moths; Mr. J. Madison, recent and fossil Planorbis, varieties of *Limnæa peregra*, foreign Helices, and a collection of models of snails and slugs; Mr. F. Shrine, a collection of British reptiles, and a number of cast skins of the ring snake, *Tropidonotus Natrix*; Mr. A. T. Evans, fossiliferous pebbles, from the Drift; Mr. J. W. Moore, macro and micro-lepidoptera; Mr. W. H. Bath, marine algæ; Mr. Delicate, photographs of local scenery; the Society, birds of the district. Not the least interesting part of the exhibition was the collection of microscopes, under which many interesting and unique objects were shown. The meeting was largely attended, and the efforts of the members to excite an interest in the beauties of creation were widely appreciated. —February 6th. A paper was read by Mr. W. Flower, "Notes on the Hive Bee." The writer said bee-keeping was a profitable undertaking if properly studied, and if advantage were taken of the latest improvements in hives. The artificial stamped wax foundation saved much time and waste, and the use of the extractor to remove the honey from the comb allowed it to be used again. The development of the bee from the egg to the imago, male or drone, imperfect female or worker, and perfect female or queen, was fully explained, as well as the different treatment given to the larva of a worker, which would produce a queen if required. The writer considered the various kinds of bees, and remarked on those most suitable for bee-farming. At the close of the paper a modern hive was exhibited, and specimens of comb showing worker, drone, and queen cells, and the members were invited by the writer to inspect his bees at work.—February 13th, Mr. Corbet showed specimens of measled pork. Mr. J. Rodgers, then read a paper on "The Moon," which described it as a world very similar to our own, but without seas or atmosphere, in fact, a worn-out world. By the aid of photography its surface has been as fully explored as some parts of the earth. Observations show that the causes that have brought about the physical features of its surface, are the same that have moulded the surface of the earth; but the scenery of the moon was sharper and showed more asperities from the fact that it has not suffered much from denudation. The plains, mountains, and craters were described, the first as being the beds of dried-up seas, in some cases showing the effects of erosion and disintegration on their margins. The writer concluded that the moon, at one time similar to the earth, was now destitute of life, though formerly capable of supporting it. The paper was illustrated by diagrams of lunar scenery, &c.

THE PRESENT AND FUTURE OF SCIENCE TEACHING IN ENGLAND;
WITH SPECIAL REFERENCE TO BOTANY.

ADDRESS TO THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY, AS RETIRING PRESIDENT, BY

W. HILLHOUSE, M.A., F.L.S.

PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY, MASON SCIENCE COLLEGE, BIRMINGHAM).

When you did me the honour—thirteen months ago—of election to the office of President of this Society, I entered upon its duties with much inward trepidation, knowing that I was following immediately in the wake of a gentleman as much distinguished for urbanity of manner as for energy in work, as much characterised by scientific ability as by willingness to place his knowledge at the disposal of others. Relying, however, upon a courtesy which I had then never known to fail, and upon the warm co-operation of officers who had in many cases grown grey in the active service of the Society, I entered upon my task with the firm determination that during my term of office the interests of the Society should be ever present in my thoughts; and that, if I could not occupy a position upon a level with my predecessors, I would at least allow myself no cause for shame at the extent of the gap which separated me from them.

It is now my duty to follow a custom which time has consecrated, to place a memorial stone upon my year of office by addressing you upon some topic with which I may feel myself to be more or less at home. If I have selected as my subject "The Present and Future of Science Teaching in England, with especial reference to Botany," it is because I feel, not that I have anything to say which is new or striking, but that, as botanist and as educationalist, my qualifications, whatever they may be, are here likely to meet on common ground.

We have all read the wondrous story of creation's dawn as pictured in Mosaic writ. The account there given of the evolution of Cosmos from Chaos—the starting up of sequent myriads of organised beings at a Creator's word—is one which appeals strongly to an imagination overwhelmed with a sense of the vastness and grandeur of the universe, and the nothingness of the foremost of its denizens. But, nevertheless, it leaves a void behind. With all its poetic beauty, there is in it no sign of the eternal fitness which alone can give to it a

sense of probability. It may appeal to the emotional, but it gives no hold to the intellectual part of man to be told of an unending series of different organisms produced by instant but independent creation—organisms of, from the first, such evenly balanced hostility and power, such divers needs and capabilities, that the mere attempt to dwell on the details of their contemporaneous existence seems once more to reduce our mental Cosmos to primeval Chaos. We look in vain for the history of the animal or vegetable denizens of this earth, for their inter-relations, their mutual dependence, and their mutual destruction, for if food was in any way necessary to existence, destruction whether of animal or of vegetable life must have ensued.

But many of us, would that I dared to say all of us, have read another account of Creation's dawn, as given in the "Origin of Species" by, and with all reverence I say it, one who is as pre-eminent in the enunciation of the physical, as was Moses in the enunciation of the moral law. Charles Darwin has painted for us the missing history, the physical history of creation; and, as the narrative of the Hebrew Law-giver derives its first mark of distinctiveness from the picture of the moral conflict between right and wrong involved in the history of the Fall of Man, so that of our nineteenth century Moses derives its reality by depicting to us the incessant struggle between strong and stronger, which is the accompaniment to our physical life. We know that the doctrine of a constant struggle for existence is true, for we know that the sum total of life is limited by the sum total of food, and that while the tendency of all life is to increase and multiply, the sum total of food supply remains more nearly constant. Hence it follows that the sum total of life must remain pretty constant too, other than with such changes as are brought about by the reduction of the food needs of any kind of organism, and that therefore the periodical increment of life must be in some way or other reduced or rendered null.

We know, I say, that this struggle exists. Who has not seen the contest of the weeds for proprietorship of a piece of waste land, and the ultimate victory of the grasses, as endowed with the strongest vitality? But if you want to feel the inevitable nature of the struggle, let us imagine the vast surrounding ocean of this globe containing but one single fish, and that a female herring, with just such a roe as that which, under the name of "hard," you have all, doubtless, often eaten, with its thousands of tiny eggs, each a potential herring. I do not know how many eggs a herring's roe contains, but let us assume, if you will, 2,000. Of these 1,000,

we will say, become female herrings (and in this matter the number of males becomes of secondary importance), and that they spawn once a year: in the

1st year the herring has produced		1,000
2nd „ these have produced	...	1,000,000
3rd „ „ „ „	...	1,000 millions
4th „ „ „ „	...	million millions
5th „ „ „ „	...	1,000 million millions

And so on.

How many years, think you, assuming (I grant an impossible assumption) unlimited food supply, would it take for the present seas to be packed full of a solid mass of herrings, the displaced water having sought a home elsewhere? Perhaps the cubic capacity of a herring is six cubic inches, if so, 8,000 fill a cubic yard; and though in the second year we shall have but 125 cubic yards of herrings, in the third year we shall have 125,000 cubic yards, in the fourth year 125 millions, and in the fifth 125 thousand millions—that is, upwards of 20 cubic miles; in the sixth year 20,000 cubic miles, and in the ninth year 20 million millions of cubic miles; that is, unless my arithmetic is at fault, in the ninth year our solitary female herring would have produced a mass of herrings equal to 60 or 70 times the entire solid bulk of this globe upon which we live. Nay, more than this, for we have dealt only with the female herrings, and probably an equal bulk of males would be produced; and even then in our calculation we have assumed the death, nay more, the disappearance, of all herrings excepting those of the present year. This is preposterous, you will say, and so it is. But why is it preposterous? Surely not because some proportion of the eggs may be infertile or unfertilised, for at the most that would but delay for a few years the startling consummation already pourtrayed. No! our premises are impossible; the potentiality of herring eggs is limited by the quantity of herring food, and starvation would await the overwhelming majority of the herrings born, even assuming that starvation does not abort the vast majority of the eggs themselves. In this natural case of supply and demand, this instance of Nature's Malthusianism, this struggle amongst multiplying herrings for limited food, two classes of herrings would survive:—

(1.)—Those of more robust growth, which would by sheer force kill off their weaker brethren, and

(2.)—Those which were capable of sustaining satisfactory life on the smallest amount of material.

Now, although in our actual case we have not to deal with herrings alone, but with fish of other kinds as well, the

principle involved is the same: the survival of those which are marked either by greater strength, stronger vitality, or slighter needs,—the survival of the fittest.

And the law that is true for the herring is true for the man also, and with this addition, that the struggle for food, which once, no doubt, was the sole characteristic of an archaic human race, has been complicated by a struggle for possession and power. We have become very far removed from the period when the sole need of man was food; who can tell how early in the history of the race the struggle for the possession of women was added to it? And to that has been superadded the desire of many other possessions which are limited in quantity, and even the struggle for power as well. Why, this small island of ours, has it not, within that feeble span of time known as "historical period," been the seat of struggles between Briton and Roman, Gael and Celt, Saxon, Dane, and Norman? No doubt most of these struggles have been struggles not for food ostensibly, but for power; but what is power, but the right to eat, be clothed, and be served by the labour of others instead of by one's own personal exertions? And the struggle for money to-day is the precise equivalent to this mediæval struggle for power, for to us moderns "money is power," *i.e.*, is food and clothing, and service, yea, and pride as well.

And now I would wish to draw your attention to one phase of this struggle for food, possessions and power, which is of vital importance to our own subject. The Hebrew Law-giver introduced us from the first to the moral element in man's nature, the conflict in him of the powers of right and wrong, and the evolution of his constant mentor—conscience. Darwin has given us an insight into the physical side of life, and the incessant struggle amongst all organic creation, including man, for the mere right to live. Perhaps some third Moses, some greater than Herbert Spencer or Kant, may some day unfold to our vision the development of the intellectual faculties, and thus correlate our knowledge of the beginnings and history of mind and matter, soul and conscience.

And surely the time is ripe for this, for if any one thing is more certain than any other, it is that, century after century, year after year, in the history of any advancing section of the human race, empire has been more and more shifting its seat from the muscle and sinew to the nerve and brain. Why, even our very wars, those crudest relics of primeval struggles for food, possession, and power, are fought to-day more with the brain than with the arm. The days of knightly chivalry, when victory lay with the strongest arm, the straightest lance,

and the keenest sword, are gone for ever; one modern invention will work more destruction than a hundred knights, with their men at arms, and that, too, at distances which might o'erleap half-a-dozen mediæval battle fields. Surely the race is not to the swift, nor the battle to the strong, unless it be to the strong in brain, the swift in thought. It would almost appear as if the modern equivalent for *mens sana in corpore sano*, is that the primary object of a sound body is to keep and support a sound mind.

Five hundred years ago the visible contests of our race, as well as the invisible ones, were fought and won by the keen eye, strong arm, skilled hand, and ready foot of our fathers. The result of such a contest depended in the main upon these factors, and, like the wise men that our forefathers in their day and generation were, the education of the male member of society was confined almost entirely to the strengthening of the body, the training of the eye, the hand, and foot. But the inventor of gunpowder undid all that—by slow degrees it's true, but none the less surely. What was the strongest man against a missile which would penetrate a breastplate at hundreds of yards? And so the system of warfare ceased gradually to be one of keeping troops in compact masses, and of trusting to the shock and weight of heavily limbed and armoured men. And with the spread of weapons of precision and range, even the historic "thin red line" is almost a thing of the past, and the actual contact of bodies of armed men is being slowly replaced by the artillery duel at long range, and battles are decided, like games of chess, by superior skill in manœuvring,—true, not bloodlessly; would that they were!

And this is but an emblem of those invisible, but none the less real, contests which form the vast proportion of our struggle for existence. While it is not possible to say that there are no occupations in which bone and muscle are of less value than an active brain, it is none the less true that their number is diminishing, and that there are few indeed in which machinery, the produce of the brain, has not begun to play its part. Thus, then, man contends with man in his own trade, trade conflicts with trade, nation with nation. The reward of victory is money, the right and means to live; the result of defeat is starvation, more or less complete. There is war—civil as well as international—constantly raging, none the less cruel, none the less pitiless, because it is a bloodless war, and is fought with brains instead of arms.

Now, if it was essential in olden time that men's arms and legs, muscles and eyes, should be trained by constant exercise, because upon them fell the brunt of the warfare for the right to live; so now it is equally essential that men's—aye, and

women's—brains should be trained and strengthened, because, in the altered conditions of things, it is upon them that we depend in the main for livelihood. Not that muscle has gone out of use, but simply that it has become subservient to the brain. If it be true that "the pen is mightier than the sword," is it not far more true that the head is mightier than the arm, skill is more powerful than strength?

Education is the training which fits us for the battle of life. The education of the fourteenth century was almost wholly physical, because the struggle for existence was a physical struggle; the education of the nineteenth century must be in the main mental, since the struggle for existence is now mainly solved by its intellectual constituents; not forgetting, however, that the healthiest minds reside in healthy bodies; and, still more essential, that for the production of healthy children, healthy parents are needed.

I need hardly say it is no part of my purpose to go over the whole ground of the educational question. We have so far realised the changing conditions of life, that education, of a kind, is well-nigh universal; but the question I have often put to myself, and the question I would put to you, is—Is the education which we demand and give, that which is best suited for its purpose; are we, in educational matters, on the right track?

The main distinction between ancient and modern warfare, whether in blood or industry, is that the latter is wedded in the closest way with physical science (using this term in its broadest possible sense). All the great victories of peace of this Victorian era have been victories of science; all the great victories of war have been victories gained by science. If, then, the conflict is so essentially a scientific contest, of course the training for the conflict is essentially a scientific training! But is this so? What part I would ask does science play in the education of our people? What proportion of the thirty weekly hours of an average schoolboy's existence is given to physical or biological science, the knowledge of the world which surrounds him, of the laws which govern his existence, and which will govern him in his struggle for the power to live? Is it one-half? No. One-quarter? No. Doubtful, even, if it is one-eighth in the best of cases, and from that it sinks away to nothing! And yet we pride ourselves upon being a practical people, when it is doubtful whether one more unpractical, more improvident, exists upon the face of this earth. Whence is it, then, that this want of appreciation of the teachings of experience comes?

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 76.)

Carbonate of lime in water decomposes about 10½ times its weight of common yellow soap, and nearly 9 times its weight of white curd soap in the operation of washing. Other salts of lime or magnesia destroy an amount proportionate to the lime or magnesia they contain. The lime unites with the stearic, or other fatty acid present in the soap, forming the stearate or other salt of lime, and until the lime is so satisfied no lasting lather can be obtained. It follows, therefore, that the water is softened at the expense of the soap, and this is accompanied with the production of insoluble curdy bodies (insoluble soaps).

Considering the large amount of soap used, a soft water is very desirable. Soft water is also much better for making tea, and for most manufacturing processes—brewing being an important exception.

Where a hard water only is available, it would generally be both beneficial and economical to soften it by Clark's process. I believe the Marlstone water might be so treated with advantage to the town. After making large allowances on account of water used for purposes where hardness is of no account, the value of the process may be estimated by the following figures:—

To soften the same amount of water by—

		£	s.	d.
Lime, 1 cwt.	about	0	0	9
Carbonate of Soda, 4¾ cwt.	,,	1	13	0
Soap, 20¼ cwt.	,,	28	0	0

To soften by boiling would be about as expensive as by soap.

At Caterham a very hard water is reduced from 21·2° to 4·4° at a cost of less than £1 per million gallons.

Some waters are greatly benefited in other ways by this artificial softening, as will be explained further on.

Excessive hardness.—A contaminated subsoil or water-bearing bed gives to water percolating through it the power to dissolve large quantities of salts, thus producing excessive hardness. According to recent investigations of Mr. Warrington*, the silica is not increased, and the quantity of carbonates but little. Lime is considerably increased, and

* "A Contribution to the Study of Well Waters," by Robert Warrington, F.R.S. "Journal of the Chemical Society," June, 1887.

magnesia still more. Sulphates are very largely increased. It is the permanent hardness therefore that is chiefly increased. It is scarcely necessary for me to point out that some waters may be highly charged with mineral matter derived from the rocks through which they pass, without any contamination, so the general character of a water-bearing bed must be known before attributing excessive hardness in the water derived from it to contamination.

ORGANIC CONTAMINATION is a much more serious matter than inorganic, and animal matter more dangerous than vegetable, hence any analysis should be chiefly directed to the detection of the former. Animal and vegetable substances contain practically the same things, as a consequence of animals living on vegetables or other animals, but the proportions of these constituents vary. Animal matter contains more nitrogen relatively to the carbon than vegetable; also the excrement of human beings is characterised by the presence of more chlorine, in consequence of the great use of salt as a condiment. A determination of the relative amounts of organic carbon and nitrogen may be very valuable in a recently contaminated water, but since decomposition of the organic matter converts the carbon into carbonic acid gas, and this can no longer be specifically identified from that otherwise introduced, whereas the nitrogen still remains, the method does not seem of general application.

Sewage matter is, unfortunately, very often discharged into, or allowed access to water which must be used by human beings. This matter is not only itself injurious, but it may at any time contain those living germs which are both the product and cause of diseases of an epidemic character. The most objectionable part of sewage in water is that held in mechanical suspension, and not that held in solution, for when the organic matter is fully decomposed the products, though soluble in the water, are not themselves injurious, because incapable of further change, at least of an objectionable kind, in the human body.

Micro-organisms.—With the suspended matters we must class the living organic germs, for it is impossible to conceive that they could suffer solution, and consequent diffusion in the water, and at the same time retain their vitality. A chemical analysis fails to detect the presence of these organisms, and unless they are abundant a microscopic examination may also; hence it is important to know whether they retain their vitality long, also whether they can be separated from the water. With regard to the first point, it is perhaps

not advisable to speak very decisively, but it does seem very unlikely that germs which find such a suitable habitat—for themselves—in the hot fluids of the body would thrive in cold water, and if not they must ultimately die out, and become burnt up. Fortunately with regard to the second point more decided evidence is available, for Dr. Percy E. Frankland has shown that filtration not only separates distinguishable solid particles, but also reduces the number of micro-organisms, the reduction extending to entire elimination, according to the number of organisms present, and the condition or extent of the filter. Spongy iron or coke are the most effective materials at present known, but it is important to know that simple agitation of the water with coke, charcoal, or chalk will effect the precipitation of these organisms, and a like result will be obtained when precipitating the lime in water by Dr. Clark's process of softening. The microbes are not killed by this latter method, and they will re-ascend into the water if it is left long in contact with the sediment.

Records of contamination.—Oxygen dissolved in water is more active chemically than the same gas in the air, and when dead organic matter is discharged into water the constituents are rapidly changed, so that to detect contamination the products of oxidation and decomposition have to be looked for.

The carbon of the organic matter is oxidised to carbonic-acid gas, which remains dissolved in the water, and cannot be identified in an aerated water, since such water would normally contain it.

The hydrogen is oxidised to water, which, of course, cannot be distinguished in the same medium.

The nitrogen is partly converted into *ammonia*, and partly into *nitrous and nitric acids*, which latter substances unite with the bases always present in water which has passed through or over the ground, forming *nitrites and nitrates;* and since rain-water only contains minute traces of the above-named acids, the presence of determinable quantities of these nitrites and nitrates is looked upon as a record of previous contamination, they are considered to be the harmless skeletons of organic bodies. In the chemical changes just referred to we have an imitation of the production of *nitre.*
Nitrates and nitrites.—It is estimated* that 97 per cent. of the combined nitrogen of London sewage is converted into nitrates during slow percolation through a stratum of gravelly soil only five feet thick. Nitrates and nitrites may them-

* Sixth Report of Rivers Pollution Commission.

selves be decomposed under conditions where there is decomposition going on with a deficiency of oxygen (see ammonia). They are always rapidly destroyed, or taken up by aerial vegetation, and to a less extent by aquatic, so that this kind of evidence may largely disappear from a water.

Ammonia.—The first thing to decompose in sewage is *urea*, and as this yields free ammonia, the presence of much free ammonia in a water is usually a bad sign; it indicates very recent contamination, for this ammonia would soon be converted into nitrites and nitrates. There are, however, cases where free ammonia does not indicate recent contamination. Filtration may indeed increase the amount of free ammonia at the expense of albuminoid ammonia.* Again, in underground waters the nitrates and nitrites may be themselves decomposed in order to yield oxygen for the oxidation of some organic matter still remaining, and then the nitrogen may be partly evolved as *ammonia* and partly as *free nitrogen*, and the latter would be lost sight of.

Protoxide of iron may sometimes reduce nitrates and nitrites, taking their oxygen to form a peroxide, and setting free ammonia. Sulphates may even be reduced by the protoxide of iron in a similar manner, and so yield *sulphuretted hydrogen.*

Albuminoid Ammonia.—Many waters contain nitrogenous organic matter in a form in which the nitrogen is only slowly evolved as ammonia by the action of strong oxidising agents, the ammonia so evolved is spoken of as albuminoid ammonia; much of this and little free ammonia would usually indicate vegetable contamination.

Chlorine is often a valuable criterion of contamination in a water, because the chlorides introduced by sewage are not filtered out, or decomposed, though they may be taken up to some extent by plants in the soil, or in a stream. If the normal quantity of chlorine in a water from any particular bed is known, then the chlorine estimation is useful as indicating, if in excess, animal contamination.

It will have been noticed that all the chemical changes just described, as occurring in water, tend to purify it, and that the ultimate products of these changes are bodies of a simple nature, bodies not liable to further change, and, therefore, not injurious in a water. I would only now point out that these changes are chiefly effected by filtration and aeration, the two operations which are so particularly provided for in the plan suggested for filling up the Marlstone.

(To be continued.)

* See "Water Analysis," by J. Alfred Wanklyn, M.R.C.S., pages 98 to 104.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 62.)

Since the publication of the last number of this history I have examined the English Flora of Sir J. E. Smith for notices of Worcestershire plants. The first edition of the Flora, in 4 vols., 8vo, was published at the following dates: Vols. I. and II., 1824; Vol. III., 1825; Vol. IV., 1828. A second edition of the whole work appeared in 1828. It has yielded the following records:—

Vols. I. and II., 1824.

Campanula hederacea. On Hartlebury Common. Rev. T. Butt. *This is the only original record of C. hederacea on Hartlebury Common, and is one of doubtful correctness, as the plant has not been seen in that locality by any other botanist. It is on the authority of the same observer that Gnaphalium margaritaceum is recorded from Wyre Forest, in the Botanists' Guide, 1805.*

Pyrola media. Wyre Forest, near Bewdley. Dr. Pratington. (*Pratinton.*)

* **Cuscuta europæa.** At Shipston-on-Stour. Rev. Dr. Jones.

* **Daphne Mezereum.** At Eastham and Stanford. Rev. E. Whitehead (*Rector of Eastham*). *This is the same record as that in Purton, Vol. III., p. 33, 1821.*

Vol. III., 1825.

* **Vicia bithynica.** Between Chockenhall and Sandling, in Worcestershire. Rev. Dr. Abbot. *Cherkenhill and Sandlin, in the parish of Leigh.*

* **Gnaphalium margaritaceum.** By a rivulet in the heart of Wyre Forest. Rev. T. Butt. *This is the same record as that in the Botanists' Guide, 1805.*

† * **Inula Helenium.** I noticed it in 1795, between Worcester and Ludlow. *But query in what county?*

Vol. IV., 1828.

Epipactis purpurata. See ante, p. 59.

* **E. ensifolia.** On the top of Abberley Hill and in Wyre Forest. Mr. Moseley.

From a notice of the life of the late Mr. Edwin Lees, in Berrow's "Worcester Journal" of the 29th October, 1887, we learn that in the year 1828 Mr. Lees, who was then a printer and stationer in Worcester, published, under the name of Ambrose Florence, a stranger's guide to the city and cathedral. I am indebted to my friend, Mr. R. F. Towndrow, of Malvern Link, for a description of this book,

which is in the reference department of the Public Library in Worcester. It is entitled "*The Stranger's Guide to the City and Cathedral of Worcester, including a concise description of every remarkable and interesting object contained therein, with an account of the Battle of Worcester, and a sketch of the principal objects of Natural History observable in the vicinity, by Ambrose Florence, Worcester, printed by Edwin Lees, 87, High Street, 1828.*" At pages 152 to 156 is "A Catalogue of Plants growing wild in the vicinity of Worcester," which Mr. Towndrow has been so obliging as to copy for me. As this is the first catalogue of plants from the neighbourhood of the city, and Mr. Lees's first contribution to the botany of the county, I have thought it worth while to reprint it, simply altering the sequence of the species and omitting the English names.

Edwin Lees in Ambrose Florence's "Stranger's Guide," 1828:—

* **Ranunculus Lingua.** Ockerley Wood, near Holt. *The locality referred to is Ockeridge Wood.*

* **Aquilegia vulgaris.** Leigh Sinton.

Papaver somniferum. Shore of the Severn.

* **Cardamine amara.** Side of Laughern Brook.

* **Dianthus Armeria.** Clerkenleap Cliff.

* **D. prolifer.** Field below Malvern Church.

A doubtful record.

* **Saponaria officinalis.** In a hedge near Mudwall Mill.

* **Montia fontana.** Plashy rills on the Worcestershire Beacon, Malvern.

* **Geranium lucidum.** Top of Merryman's Hill.

* **Vicia sylvatica.** Clifton-on-Teme.

* **Lathyrus Nissolia.** Footway to Norton.

* **L. sylvestris.** Perry Wood, &c.

Prunus Cerasus. Wild Cherry Tree, near Gregory's Mill, &c.

Must be Prunus Avium, L.

* **P. insititia.** Bullace. Hedge at Battenhall.

* **Spiræa Filipendula.** West side of Perry Wood.

* **Sanguisorba officinalis.** Side of Nunnery Wood.

* **Rubus Idæus.** In a copse at Bevereye.

* **Rosa spinosissima.** Abundant in the lane leading to the Virgin's Tavern.

R. gracilis (*a form of Rosa involuta*). Thicket near the rill that runs from Battenhall Farm; a most beautiful species.

* **R. villosa.** Battenhall and Helbury Hill.

* **R. tomentosa.** At Bransford, &c.

R. Sherardi. Thicket beyond Battenhall Lane (*a form of the preceding*).

* **R. rubiginosa.** Foot of Cruckbarrow Hill. (*Crookbarrow Hill.*)

* **R. micrantha.** At Bransford.

R. Borreri. Perry Wood, &c. *A form of R. canina.*

Pyrus torminalis. Clerkenleap, &c.

* **P. domestica.** Wire Forest.

* **Œnothera biennis.** Side of the Teme below Powick Bridge.

Circæa lutetiana. South part of Perry Wood.

* **Sedum Telephium.** Wet meadow, near Bubble Bridge.

* **Cotyledon Umbilicus.** Roseberry Rock, Knightwick.

* **Sium latifolium.** Side of Henwick Old Weir Pond.

* **S. angustifolium.** In a damp copse at Bevereye.

* **Œnanthe Phellandrium.** In a pool at Kempsey Grove.

* **Meum Fœniculum** (*Fœniculum vulgare*). Spetchley.

* **Chærophyllum sativum.** In profusion on the sides of the Tewkesbury Road, just beyond the turnpike, where Dr. Stokes noticed it in 1775.

* **Myrrhis odorata.** Side of the Royal Mount, facing the London Road.

* **Viburnum Lantana.** In the hedge of a plantation near Berwick's Bridge.

Lonicera Caprifolium. Copse beyond the Ketch.

† **Galium pusillum.** East side of Red Hill. *This must be a reference to the record by Stokes of Galium scabrum as growing at this spot. G. scabrum is a var. of G. Mollugo; G. pusillum, Smith, is a limestone plant of the northern counties, not known in Worcestershire.*

* **Asperula odorata.** Woods about Leigh Sinton, &c.

Valeriana rubra. On the old wall of the western entrance to the Cloisters.

* **V. dioica.** Meadow above Bubble Bridge on the Laughern Brook.

* **V. officinalis.** Nunnery Wood.

* **Dipsacus pilosus.** Banks of the Laughern, and in a bushy place near the Severn at Grimley.

* **Scabiosa succisa.** Near Diglis Basin, but most numerous by the side of the Droitwich Canal.

† **Campanula glomerata.** Knightsford Bridge. *Must be an error. It is not acknowledged in the Botany of Worcester as a native of the Malvern district.*

* **C. Rapunculus.** Hindlip.

* **C. patula.** Borders of Perry and Nunnery Woods.

* **C. hederacea.** On Hartlebury Common. *A repetition of the record by the Rev. T. Butt in Smith's English Flora.*

* **Pyrola rotundifolia.** Abberley Hill. *This must be a repetition of Dr. Sheward's record in Nash's Supplement, 1799.*

* **Vinca major.** Side of the road opposite Rainbow Hill, &c.

* **V. minor.** Covering the side of the copse on the red marl rock at Clerkenleap, and another at the base of Cruckbarrow Hill in a beautiful manner.

Datura Stramonium. Near Bevereye.

* **Verbascum virgatum.** South side of the lane near Gregory's Mill.

* **V. Blattaria.** Side of the road between Powick and Newland.

* **Antirrhinum** (*Linaria*) **Cymbalaria.** City walls.

* **A. majus.** Walls about the Commandery.

†* **Veronica triphyllos.** Northern extremity of the Link Common, near Malvern. *An error.*

* **V. officinalis.** Top of Helbury and Ronk's Wood Hills.

* **V. montana.** Wood at the west end of Powick Ham, and wood at the south side of Shrawley Church, near the pool.

* **V. scutellata.** Ditch on the Crowle Road.

V. Anagallis. Brook above Gregory's Mill; and with pink blossoms, side of Berwick's Pool.

* **Lathræa squamaria.** Foot of the North Hill, Malvern.

Mentha viridis. Side of a rill near Newland.

* **Salvia Verbenaca.** Side of the London Road at Red Hill.

Lithospermum officinale. Near Battenhall.

* **Anchusa sempervirens.** Under an elm tree, in a field by the river side beyond the old Water Works.

Borago officinalis. Lane at Bromwich Farm.

* **Cynoglossum sylvaticum.** Near the third milestone to Pershore.

Hottonia palustris. In a ditch near Crowle.

Primula elatior. Oxlip Primrose. Coppice near Bransford Chapel, where there are several curious varieties of Primula. *This is not the true Oxlip, but P. vulgaris, var. caulescens.*

* **P. veris,** var. Black or Deep-red Cowslip. In a pasture on Bromwich Farm.

* **Lysimachia vulgaris.** Powick Weir.

* **Polygonum Bistorta.** Near Roseberry Rock, Knightwick.

Parietaria officinalis. City walls, &c.

* **Lemna gibba.** Lower Bishop's Pool, Northwick.

* **Butomus umbellatus.** In Laughern Brook.

* **Ophrys apifera.** Cracombe Hill.

* **Neottia spiralis** (*Spiranthes autumnalis*). On Cruckbarrow Hill.

* **Serapias** (*Cephalanthera*) **ensifolia.** Abberley.

×**Iris fœtidissima.** Base of Cruckbarrow Hill.

* **Narcissus biflorus.** In the field at the top of Clerkenleap Marl Cliff, near the Ketch, two miles and a half south of Worcester.

* **N. Pseudo-narcissus.** In the thicket below, in profusion.

* **Galanthus nivalis.** On the east side of King Stephen's Embankment at Henwick.

• **Paris quadrifolia.** In a copse overshadowing a boggy glen, between Worcester and Cruckbarrow Hill.

• **Convallaria majalis.** Shrawley Wood.

Tulipa sylvestris. On Clerkenleap Marl Cliff.

Ornithogalum nutans. Field at Clerkenleap.

O. pyrenaicum. At Cotheridge.

• **Allium vineale.** On Pitchcroft.

A. oleraceum. In the same habitat as Narcissus Pseudo-narcissus.

A. ursinum. Near Cruckbarrow Hill.

• **Colchicum autumnale.** Abundant in the meadows by the Severn.

• **Eleocharis acicularis.** Severn Stoke.

• **Scirpus cæspitosus.** Bromsgrove Lickey.

Milium effusum. Wood near Powick Ham, &c.

Aira flexuosa. Helbury Wood Hill, and wood on the Broadheath Road.

Holcus mollis. Meadows on the western side of Severn.

• **Festuca Calamaria.** Shrawley Wood.

• **F. pinnata** *(Brachypodium pinnatum)*. Near Pershore.

• **Bromus diandrus.** Severn Stoke.

This is Bromus madritensis, L., and must be a repetition of Dr. Stokes's record. See With., 2nd edit., p. 107.

B. velutinus. Helbury Hill.

This is a form of Bromus secalinus, subsequently noted by Scott.

Elymus europæus. Wood Lyme Grass. Malvern Hills, near the Wych.

This is the grass now known as Hordeum sylvaticum, Hudson.

• **Nardus stricta.** Malvern Chace.

The Catalogue is disappointing in one or two particulars. No distinction is made between plants observed by Mr. Lees himself and those recorded on the authority of other observers. It does not contain a single Composite, and several other important natural orders are very insufficiently represented. The total number of plants recorded is 106, of which 27 are new records. Rosa tomentosa, R. micrantha, R. Borreri, Pyrus torminalis, Circæa lutetiana, Datura Stramonium, Mentha viridis, Lithospermum officinale, Tulipa sylvestris are contained in the List of Plants on the Malvern Hills in Loudon's Magazine of Natural History, and are entitled to precedence.

Parietaria officinalis, Milium effusum, Aira flexuosa, Holcus mollis, Bromus secalinus are entitled to precedence over the records of the same plants in Scott.

(To be continued.)

p. 120

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

V.—THE AIM OF LIFE.

FROM A LECTURE DELIVERED IN JUNE, 1879.

To what end is that vast machinery of Life, which covers everywhere, as with a delicate network, the outer surface of this flying globe? It is the puzzle of the ages, the riddle of the Sphynx, the insoluble problem. We may find out the curious processes by which a tree sucks food from the air, the rain, and the soil. We may count the bones in a human body, or calculate the leverage of muscles, or trace the fine threads by which sensation is communicated from the skin to the brain. We may roughly imitate the organic machinery, as in a watch or a phonograph, or a locomotive engine, but we cannot catch the Vital Energy itself. We cannot put *that* into our artificial apparatus. We may burn fuel under the boiler, but we cannot make our engine *feed*. We cannot make a dead stick grow, nor put a soul into a waxwork figure. Hitherto the element of life has proved too subtle for us. It may be, as some suppose, that it is no more than gravitation, or magnetism, or chemical affinity acting under more complex conditions; but to explain it thus, is only to say that the earth stands upon an elephant, and the elephant upon a tortoise, and the tortoise upon—what? If life is gravitation, what then is gravitation? Why do all the particles of matter attract one another? Why, when a ball is set in motion, will it fly on for ever until something stops it? What is this Force, this Energy, which is at the bottom of all the actions and processes of matter whether dead or alive? In the presence of this question our philosophers stand silent. In all our researches we are met at last by this omnipresent and unexplainable Energy, and we can go no further. As far as we can see its conduct is always uniform, and may be foreseen and predicted with a certainty exactly in proportion to our knowledge of the conditions. We have learnt to trust absolutely to the uniformity of its conduct under uniform conditions, and we call its modes of action "laws of nature." But we can only watch its workings with wonder and admiration. We know of its existence only because in the human personality or soul it takes on the form of self-consciousness, and so looks back upon itself, and *feels* its own

existence, not with any material organ, but with that "inward eye which is the bliss of solitude," because there is nothing so delightful and inspiring as the vision of "things unseen."

I ask you to consider whereto is tending the work of this all-pervading Energy on the surface of this globe? Its latest and most wonderful outcome is animal life; and without doubt the completest form of animal life, of which we have any knowledge, is human life, also it is the last and latest of all vital forms.

What then is the meaning and the purpose of humanity? Why do we live and die? Why do we grow in knowledge and in power? Why do we love, and hate, and struggle after a number of objects which attract us? Why are we happy one hour and miserable the next? What is it that we chiefly want? What is our highest good, the best thing attainable, the summit and climax, the end and aim of life?

In spite of all our researches and speculations, the origin of the human race is utterly unknown to us. We are still disputing whether it was slowly developed by special conditions of climate and food, out of some lower form of animal life, or whether it flashed upon the world like the coming of a meteor; whether its first condition was that of the dark-skinned savage out of which the nobler forms have blossomed; whether the Negro and the wild Indian are degenerate offspring of a race originally fair and wise; or whether all known forms have existed side by side since first the world was habitable.

We may believe in one theory or the other, or we may trust to none of them, but the actual and present fact is plain, that between man and all other animal life there is now a deep wide chasm. Whatever may be our ancient blood-relationship with inferior races, no human being is ever now mistaken for a monkey, nor has any form of monkey been discovered which could be dignified with the name of man. There are many attributes by which man is distinguished, none more notable than this, that he is the one *discontented* being. However much he may enjoy the present, there is always something in the past which he remembers regretfully, something in the future which he anticipates with hope.

"We look before and after
We pine for what is not."

This is, no doubt, the necessary condition of a being who is still in process of development, not yet perfected, and who possesses the faculty of self-consciousness. If the rose-bud were conscious of its daily growth, it also would "look before and after," would speculate on its unseen and unknown

destiny, would feel that its path was upward towards something not yet reached, and would be stirred, as man is stirred, with golden hopes and irrepressible aspirations.

What then is it that man hopes for ? Passing by all lesser hopes and wishes, what is that which, if he could reach it, would completely satisfy him ?

Here part company two schools of thought. A thinker of one type will tell you that what man longs for is happiness; give him perfect happiness and he is for ever content. The other school repudiates this doctrine; maintains that there is a hope beyond the hope of happiness; that this highest and subtlest aspiration exists in all branches of the human family, but is strongest and clearest in the noblest souls; that it is not a desire to *have* anything, or to *feel* anything, but simply to *be* whatever the imagination pictures as the completest development of humanity. I take my stand with the latter school, and I think it of vital consequence to the progress of civilisation that the pursuit of happiness as the end and aim of life should be denounced and made as unpopular in theory as I believe it is actually untrue in fact.

NOTES ON THE WARWICKSHIRE STOUR VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 71.)

In many parts of the district the fences are of stone often loosely put togther without cement. These loosely constructed walls are rarely the habitats of flowering plants, unless it be here and there the tiny whitlow grass, but the mosses, content with a thinner soil, not unfrequently spread their velvety mantle over these otherwise bare places, and we see beautiful masses of *Hypnum cupressiforme*, *H. rutabulum*, *Homalothecium sericeum*, and rarely the creeping stems of *Leucodon sciuroides*, and the coping-stones are frequently covered by great masses of *Barbula intermedia* and *ruralis*, or the *majus* form of *Bryum capillare*, or pretty little cushions of *Grimmia apocarpa* and *G. pulvinata*, serried ranks of *Orthotrichum saxatile*, silver-tipped tufts of *O. diaphanum*, and the ubiquitous *Barbula muralis*. But in the villages these walls are usually cemented and capped with mud, and then there is often an abundant crop of *Pottia lanceolata*, *P. intermedia*, *P. cavifolia*, *Tortula aloides* and *ambigua*, and rarely *T. rigida*. Of flowering plants everywhere we are reminded of the advent of Spring by the

cheerful little *Erophila vulgaris*, and the pretty *Saxifraga tridactylites*, whilst about Brailes, Tysoe, and Whatcote, I have found *Poa compressa*, *Festuca rigida*, and *F. myurus.* The walls about Honington Hall are gay with the purple-flowered *Linaria Cymbalaria*, but this cannot claim to be more than an alien weed.

Besides these stone fences, however, the good old Warwickshire hedgerows are a conspicuous feature in many parts of the valley, and these have not only gratified my eyes with their beautiful hawthorn, apple, and rose blossoms, but have filled my vasculum to repletion with noticeable brambles, rare roses, and other plants of equal interest. *Clematis vitalba* is rare, I have only seen it at Oxhill; *Euonymus europæus* and *Berberis vulgaris* are recorded from Honington; *Rhamnus catharticus* and *Ligustrum vulgare* are frequent, the latter evidently wild. *Viburnum Lantana* and *Cratægus oxyacanthoides* occur at Great Wolford, Long Compton, and Barton-on-the Heath, *Prunus Cerasus*, a single tree, near Brailes, *P. avium*, Wolford Heath, *P. insititia* and *P. fruticans* at Illmington, Wimpstone, and Atherstone-on-Stour, and *Pyrus Aria*, a single tree, on Wolford Heath. The protean bramble is abundant in many parts of this district, the ubiquitous *R. discolor* being prevalent; besides this I have found *R. diversifolius* rather frequent. *R. rhamnifolius* at Great Wolford, Burmington, Halford, Tysoe, and Long Compton. *R. pubescens*, Atherstone-on-Stour, Tysoe, Compton Warren, and Brailes. *R. macrophyllus* (type), Hill Clump (*F. Townsend*), and Great and Little Wolford. *R. glabratus*, Compton Warren. *R. echinatus*, Compton Wynyates! (*F. Townsend*), Great Wolford, Long Compton, and Barton-on-Heath. *R. pallidus*, Little Wolford and Brome Hill. *R. cæsius*, Atherstone-on-Stour, Little Wolford, Illmington, and Halford. *Rosa tomentosa* is rare, I have only seen it at Great Wolford. *R. inodora*, a very rare Warwickshire rose, occurs near Oxhill; but the dog-rose with its many forms is beautifully abundant. The robust *R. surculosa* grows about Oxhill, Eatington, Illmington, and Wimpstone. *R. frondosa*, Lower Tysoe and Oxhill. *R. tomentella* (type) only near Whatcote. *R. andegavensis*, Illmington and Wimpstone. *R. glauca*, Illmington. *R. subcristata*, Lower Tysoe and Oxhill. *R. Watsoni*, at Oxhill, on the way for Whatcote.

Whilst there is abundant evidence that that portion of the Stour Valley south of Brailes Hill has formerly been heath land, there are now no heaths such as we get in North Warwickshire, that is, wild wastes covered with abundant heather, ling, gorse, broom, and wood sage. The land has

been reclaimed and is either arable, meadow, or woodland. and the isolated spots still to be found yielding true ericetal plants are merely the survivals of a wilder past. Near Great Wolford is one of these places. It consists of a couple of pastures, having a large pool at one end, and surrounded on all sides by woods and coppices, and the following plants, the result of a two hours' examination, will give some idea of the former prevailing flora. Here, for the first time in this district, I saw *Nardus stricta* in abundance; with this was also growing *Erica Calluna*, *Erica cinerea*, *Carex præcox*, *C. pilulifera*, *C. pallescens*, *C. binervis*, *C. fulva*, *C. panicea*, *C. flava* var. *minor*, *C. pulicaris* in wonderful abundance, *C. rostrata*, *Myosotis versicolor*, *M. collina*, *M. umbrosa*, *Festuca ovina*, and var. *capillata*, *Sieglingia decumbens*, *Montia fontana*, *Taraxacum palustre*, *Juncus supinus*, the small heath form of *Potamogeton polygonifolius*, *Veronica scutellata*, *Zannichellia palustris*, *Scirpus fluitans*, *Peplis Portula*, *Callitriche obtusangula*, *Myriophyllum alterniflorum*, *Galium saxatile*, *Galium Witheringii*, *G. uliginosum*, *Sium erectum*, *Apium inundatum*, *Triglochin palustre*, and *Aira flexuosa*. I was unable to find another spot in this locality so prolific in true heath plants, but saw isolated examples at intervals, among these *Callitriche hamulata*, *Catabrosa aquatica*, and *Stellaria uliginosa*.

I also found in the same locality some noticeable mosses, such as *Aulacomnium palustre*, *Pogonatum aloides*, *Hypnum splendens*, *H. brevirostre*, *H striatum*, *H. myosuroides*, *H. piliferum*, *H. glareosum*, *Polytrichum formosum*, *Dicranella varia*, *Dicranum palustre*, *D. scoparium*, and, what was more pleasing, *D. undulatum* (Ehrht.), which was new to Britain. Several Hepatics were noticed: *Cephalozia bicuspidata*, *Pellia epiphylla*, *Scapania irrigua*, and *S. nemorosa*.

Another spot near Illmington, which has more the aspect of a moorish pasture, plentifully covered with *Ulex europæus*, and with several small marshy pools, yielded many interesting plants, such as *Œnanthe Lachenalii*, *Œ. fistulosa*, *Myosotis palustris*, *Ranunculus Drouetii*, *R. tricophyllus*, *Glyceria pedicellata*, *Molinia cœrulea*, *Gentiana Amarella*, *Samolus Valerandi*, *Thymus Chamædrys*, *Carduus acaulis*, *Chara fœtida*, and the rare *Tolypella glomerata*. This locality was also rich in mosses, such as *Fontinalis antipyretica*, *Hypnum giganteum*, *H. fluitans*, *H. intermedium*, *H. Kneiffii*, *H. cordifolium*, *H. lycopodioides*, and *H. elodes*, the two last being new to the county. Also, among the Hepatics, *Pellia calycina*, *Aneura pinnatifida*, *Calypogeia Trichomanes*, and *Radula complanata*. On the drier parts of this common there was an abundance of *Hypnum molluscum* and *Camptothecium lutescens*. Near Tysoe and

Brailes are also some gorsey declivities which still show evidences of a former wilder condition. These are deep descents falling from an elevation of about 700 feet to about 350 feet, and yield some of the plants already noticed, and, in addition, abundance of *Apargia hirta*, and *Bidens tripartita*.

Coming, lastly, to the waters of the district, I am not able to give so full an account as I should have wished. The long dry summer of 1887 was unfavourable for the investigation of these places; deep pits and pools were in many cases quite dried up, and the beds of several of the streams were without trace of water. The River Stour itself is very unlike the river I noticed in a former paper, the Anker, for in the Stour we see no great tufts of *Butomus* or *Scirpus lacustris*, or forests of *Lythrum Salicaria*, or *Glyceria aquatica*, or floating masses of *Sagittaria* or *Potamogeton natans*, such as constantly occur in the Anker; but usually a narrow rapid stream with comparatively bare banks and but few aquatic weeds. Still, now and again we meet with aquatics in abundance, as at Halford Bridge, where *Potamogeton flabellatus* is wonderfully abundant and *P. lucens* may also be seen. *P. perfoliatus* I saw in the river at Burmington, *Sagittaria* and *Butomus* are both recorded from Honington, *Lythrum Salicaria* and *Myriophyllum spicatum* are recorded from Halford, and *Hesperis matronalis* Mr. Townsend records from near Honington. Among the plants recorded by Mr. Newbould from Honington are the rare *Apium graveolens*, *Epilobium roseum*, and *Samolus Valerandi*, and on the river bank near Burmington I noticed *Petasites vulgaris* abundant.

The total recorded flora of the Stour Valley is now 688 flowering plants, ferns and fern allies, and 122 mosses. I think it very probable that several more flowering plants will be added to the list by a more thorough examination of some of the woods and other places in those portions of the district remote from railway stations, and I am persuaded that the moss flora will be materially augmented, as the time given to the district has been too limited to allow this portion of the flora to be exhaustively worked.

Classes of Citizenship.—These have been ably defined by Mr. Hewett C. Watson in the "Compendium of the Cybele Britannica" thus: "*Native.* Apparently an aboriginal British species, there being little or no reason for supposing it to have been first introduced into this island by human agency;" as examples: *Corylus*, *Bellis*. "*Denizens.* Apparently wild, but liable to suspicion of having been introduced by human agency, whether by design or by accident;" as examples: *Chelidonium*, *Vinca*. "*Colonist.* A weed of cultivated land,

or by roadsides, and seldom found except where cultivation exists;" as *Ranunculus arvensis*, *Alopecurus agrestis*. "*Alien* species are those plants certainly or very probably of foreign origin;" as *Acer Pseudo-platanus*, *Sedum reflexum*. "*Casual* species are chance stragglers from cultivation, such as are found on waste heaps, railway embankments, and sometimes in cultivated fields;" as *Trifolium hybridum*, *Medicago sativa*.

The 688 plants found in this valley are made up as follows:—

Natives	502
Denizens	12
Colonists	26
Aliens	18
Casuals	5
Varieties	80
Species not classified by Watson ...	45
	688

The twelve *Denizens* are *Chelidonium majus*, *Hesperis matronalis*, *Geranium pyrenaicum*, *Melilotus officinalis*, *Sedum reflexum*, *Ægopodium Podagraria*, *Sambucus Ebulus*, *Matricaria Parthenium*, *Vinca minor*, *Chenopodium Bonus-Henricus*, *Ulmus suberosa*, *U. montana*.

Aliens.—*Cheiranthus Cheiri*, *Corydalis lutea*, *Cochlearia Armoracia*, *Dianthus Armeria*, *Acer Pseudo-platanus*, *Medicago sativa*, *Ribes nigrum*, *Sedum album*, *Linaria Cymbalaria*, *Populus alba*, *P. nigra*, *Taxus baccata*, *Elodea Canadensis*.

Casuals.—*Brassica Rutabaga*, *Stellaria nemorum*, *Melilotus arvensis*, *Trifolium hybridum*, *Vicia sativa*.

The species not classified by Watson are the segregate species of Batrachian Ranunculi, and of the genera *Rubus*, *Rosa*, *Salix*, *&c.*, placed under a separate number in the 8th edition of "The London Catalogue of British Plants."

Types of Distribution.—In making out the types of distribution of the plants found in the Stour Valley I have again had recourse to Mr. Watson's valuable work, in which he gives six leading types of distribution, which may be briefly shown thus:—

1.—British Type.—Species widely spread through South, Middle, and North Britain.

2.—English Type.—Species chiefly seen in S. or S.-M. Britain.

3.—Scottish Type.—Species chiefly seen in N. or N.-M. Britain.

Intermediate Type.—Species chiefly seen in Mid-Britain.

4.—Highland Type.—Species chiefly seen about mountains.

5.—Germanic Type.—Species chiefly seen in East Britain.

6.—Atlantic Type.—Species chiefly seen in West Britain.

For the sake of comparison I give the following table, which will show the distribution of native plants throughout Great Britain and the relative distribution in the Valley of the Stour:—

Types.	Britain.	Stour.
British	532	386
English	409	144
Germanic	127	5
Atlantic	70	0
Scottish	81	4
Highland	120	0
Intermediate	37	2
Local	49	0
	1,425	541

Having, in a somewhat incomplete way, given an account of the Flora of the Stour Valley so far as my present knowledge serves, I may now, in conclusion, mention those plants not at present recorded, and which, taking into consideration the soils and other belongings, may yet be found in this valley. As, for instance: *Ranunculus circinatus*, *Nasturtium palustre*, *N. amphibium*, *Cardamine amara*, *Genista tinctoria*, *Trifolium arvense*, *Vicia tetrasperma*, *Valeriana dioica*, *Achillea Ptarmica*, *Tanacetum vulgare*, *Campanula Trachelium*, *Veronica montana*, *Rumex Hydrolapathum*, *Euphorbia amygdaloides*, *Allium ursinum*, *Luzula maxima*, *Carex acuta*, *Milium effusum*, *Melica uniflora*, and *Poa nemoralis*. All these are widely spread in the county, and most of them are plants which one would naturally expect to see in many parts of this valley. All have been carefully looked for during the past season, so that even if not absent they must be rare in the whole district.

Other absentees are local in the county as a whole, and will probably be very local in this district. Among these are such plants as *Helianthemum Chamæcistus*, *Lepigonum rubrum*, *Hypericum humifusum*, *Geranium lucidum*, *Erodium cicutarium*, *Geum rivale*, *Potentilla procumbens*, *Rosa micrantha*, *Chrysosplenium oppositifolium*, *C. alternifolium*, *Echium vulgare*, *Pedicularis palustris*, *Daphne Laureola*, *Parietaria officinalis*, *Potamogeton zosterifolius*, *Carex paniculata*, *C. echinata*, and *Ophioglossum vulgatum*.

THE RECENT LANDSLIP AT LAKE ZUG.*

BY WM. PUMPHREY.

It is needless to dilate on the exceeding beauty of the Lake of Zug. Whether we stroll along its banks, glide over its blue-green waters, or look down on it from the heights of the Rigi, the idea that it leaves on the mind is that nothing like treachery or lurking danger can possibly be hidden under so peaceful an exterior; and yet, the recurrence of disasters similar to that of last July seems to indicate that all is not as secure as it seems.

The eastern side of the Lake of Zug is formed by a range of hills, hardly mountains, but which, at its southern extremity, rises into the Rossberg, so well-known as the source of the great berg-fall or land-slip of 1812. The town of Zug stands at the north-eastern corner of the lake, where the hills, still keeping a northern direction, leave the shore of the lake; thus the greater part of the town is backed up by hills, but a suburb turns westward and follows the shore of the lake. All this northern shore, and the country for some miles to the north of it, is very level, and is traversed by several small streams that find their way into the lake; while at the north-western angle the waters discharge themselves by a river, which, a few miles further down, joins the waters of the Reuss that issue from the lake of Lucerne. The high road, from Zug to Lucerne, runs along this northern shore of the lake, and a street of houses—chiefly of wood—extends for about half a mile along the road, at a distance of some thirty or forty yards from the margin of the lake. The railway station is very near this street, and has near it a pier at which the steam-boats that ply on the lake land and embark such passengers as have arrived by railway, &c., or are about to depart by it. Within sight of this pier is another pier close to the town, and at this all the steam-boats call before they arrive at the railway pier. In passing from the town pier to the railway pier, the steam-boat crosses a shallow bay, which is fringed by the suburban street of which I have spoken.

On July 5th, about noon, as the steam-boat was crossing this shallow bay, the passengers could scarcely credit the evidence of their senses when they saw some of the houses, which formed a portion of the street, sink down and disappear. Later in the afternoon other buildings gave way, and before

*Read at a Meeting of the Birmingham Natural History and Microscopical Society, Geological Section, November 15th, 1887.

the day was over about thirty houses, among which was a new hotel, had fallen. In the first fall a considerable number of persons, perhaps between twenty and thirty, were drowned, or crushed among the ruins; later in the day no loss of life occurred. There have been in Switzerland many land-slips and many subsidences, but this differs from almost all others. Here there was no sliding down, no forward-thrust from any moving mass, but, almost without a warning, a portion of a street of houses standing on a dead flat sank down, and in a few minutes, where substantial buildings had stood, there was nothing but mud and water and floating wreck.

Our party was staying for a few days at Lucerne, and when, on the morning of the 6th, the news reached us, it seemed almost incredible. We could not but think that the disaster was exaggerated, and, as Lucerne is only about eighteen miles from Zug, we determined to run over and see for ourselves. We went, armed with cameras, for we hoped to obtain trustworthy mementos of the calamity. We found the little town in a state of great excitement, its usually quiet streets thronged with Switzers from all parts of the Confederacy, but of the ruins we could see but very little. The state of things in the neighbourhood of the fallen houses was so perilous that no persons, except those engaged in removing furniture, &c., were allowed to approach, and the soldiers of the Canton guarded every point of access. We were therefore obliged to return to Lucerne with scant information, but well satisfied with having made the attempt. The Rev. E. Hill, of St. John's College, Cambridge, who visited the spot about a fortnight after the disaster, when the excitement had passed away, and when no further danger or damage was apprehended, and when consequently it was comparatively easy to investigate the cause of the catastrophe, read an interesting paper on the subject at the meeting of the British Association in Manchester. He stated that the soil, for the first ten or twelve feet, consisted of silted matter, the detritus brought down by the streams, and which detritus forms the level flat spoken of above as existing at the northern end of the lake, Below this tolerably firm stratum there exists, to an unknown depth, a soft, spongy, semi-fluid formation, which, were it not for the waters of the lake, would ooze out and occupy a still lower level. Under ordinary conditions the pressure of the water maintains the ooze in its position, but any circumstances that would disturb this pressure, or increase the weight of the super-incumbent mass, would have a tendency to destroy the equilibrium, and cause a movement towards the deeper parts of the lake's bed.

Now, there have been, within historic times, two previous subsidences similar in kind to that which has just occurred—the one about 400 years ago, and the second 100 years since. On both of these occasions the subsidence appears to have been initiated by engineering operations, by which the level of the waters of the lake was suddenly lowered, and, as a consequence, the support they gave to the ooze removed. On the present occasion, the theory is that the accumulation of buildings had exerted such an increasing pressure on the upper stratum, that the weight was sustained with difficulty; that a condition of unstable equilibrium resulted, and that this unstable equilibrium was disturbed by some pile-driving operations which were proceeding in connection with the formation of a new pier. It is supposed that the concussions arising from this cause disturbed the pressure and the firmness of the supporting medium, and that the ooze, having lost some of its support, slid forward, and let down the strata above, bringing with it the houses, &c., that were erected on its surface.

THE DISCOMYCETES OF THE BIRMINGHAM DISTRICT.

BY W. B. GROVE, B.A.

The publication of Mr. Phillips' Manual of the British Discomycetes affords a good opportunity for the revision of the species of that group which have been noticed in the three counties of this district. The following list is founded chiefly on the specimens preserved in my own herbarium, but to make it more complete, all the other species of which I can find trustworthy records have been added.

The total number contained in the "Manual" is 615, of which a few over one hundred, or a sixth part of the number found in the whole British Islands, have as yet been discovered here. It will be noticed that the Discomycetes, in Mr. Phillips' acceptation of the term, embrace some species which have been usually regarded in this country as more closely allied to the Hysteriaceæ.

I have marked with an (=) those of which I myself possess specimens, all of which have been carefully revised and compared with the descriptions in the "Manual." Many of these have been confirmed or named by Mr. Phillips himself, to whose constant and willing help I take this opportunity of acknowledging my indebtedness. The records

collected from other quarters have been indicated by a cross (×); a few have been communicated by Mr. Bagnall, and the rest are from Withering and Purton, and from Lees' "Botany of Worcestershire," or from the "Manual." Six recorded by Purton from the neighbourhood of Alcester, but without definite locality, are indicated by "Midlands."

	Wk.	Ws.	St.
Morchella esculenta	=		
rotunda		=	
semilibera	×	×	
Helvella crispa	=	×	
lacunosa	×		
elastica	×	×	
Leotia lubrica	=	×	
acicularis	=		
Mitrula paludosa	×		
Spathularia flavida		×	
Geoglossum hirsutum	×		
glabrum	=	×	
Rhizina undulata	=		
Peziza cupularis	×		
onotica		×	
leporina	×		
aurantia	=	=	=
badia		×	
cochleata	=	=	
micropus	×		
venosa	×	=	
vesiculosa	=	=	
cerea	Midlands		
Crouani	×		=
asperior	=		
polytrichi		=	
rutilans	×		
humosa	=		
granulata	=	=	
omphalodes	=		
Hymenoscypha			
tuberosa	=		
Curreiana	=		
firma	=		
tuba	×		
coronata	=		
virgultorum	=		=
fructigena	×		
calyculus	×		
scutula	=		
hyperici *Karst.*	=		
cyathoidea	=	=	=
solani	=		=
Chlorosplenium			
æruginosum	=	=	
Helotium ferrugineum	=		
citrinum	=		
uliginosum	=		

	Wk.	Ws.	St
Helotium pallescens	=	=	
phyllophilum	=		
claro-flavum	=		
pruinosum	=		
herbarum	=		
Mollisia cinerea	=	=	=
Riccia	=		
urticina *Peck.*	=		
atrata *var.* plicata	=		
trifolii	=		
Lachnea coccinea	=	=	
macropus	×		
hemispherica	Midlands		
Sumneriana	×		
umbrorum	=	=	
umbrata	=		
scutellata	=		
stercorea	=	=	
theleboloides	=		
Dalmeniensis	=		
Lachnella cerina	=		
palearum	=	=	
calycina	=	=	=
nivea	=	=	
virginea	=		=
apala	=		
sulphurea	=		
dematiicola	=		
hyalina	=	=	=
Tapesia cæsia	=		
eriobasis	=		
fusca	=	=	
Boudiera areolata		=	
Ascobolus glaber	=	=	
denudatus			×
furfuraceus	=		
immersus	=	=	
Ascophanus			
minutissimus	=		=
carneus		=	
pilosus	=	=	
ciliatus	=		
Bulgaria inquinans	=		
Vibrissea leptospora	=		
Ombrophila sarcoides	=		
Pocillum Boltonii, *Ph.*	=		
Calloria stereicola	=		
leucostigma	=		

	Wk.	Ws.	St.
Calloria fusarioides	=		
vinosa	=		
rubella	=		
Encœlia fascicularis	Midlands		
Dermatea nectrioides		=	
carnea, *var.*		=	
amœna	=		
cerasi	×		
Cenangium prunastri		×	
ferruginosum		=	
Propolis pyri	=		
versicolor, alba	=	=	
Phacidium radians		×	
ilicis	=	=	
rubi	×		
dentatum	Midlands		
Stegia ilicis	=	=	=
Less certain records.			
Peziza tectoria		×	
Helotium lenticulare	Midlands		
Lachnella bicolor	Midlands		

(To be continued.)

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, February 21st. Mr. T. H. Waller, B.A., B.Sc., in the chair. Twenty-three members present. A very interesting series of photographic views, taken by Mr. C. J. Watson, in Wales, was exhibited by Mr. Chas. Pumphrey with the oxy-hydrogen lantern. As each view was projected on the screen, Mr. C. J. Watson pointed out its special features. Among the views particular mention should be made of Conway, the Fairy Glen, Aberglaslyn Pass, Pass of Llanberis, and Mawddach Valley. The attention of the section was continually drawn to the distinctive marks of glaciation so abundantly shown in the photographs. Mr. C. J. Watson showed some fine specimens of minerals from Wales, including galena, blende, quartz crystals, calcspar, &c. Mr. Chas. Pumphrey has kindly consented to exhibit (by the oxy-hydrogen lantern) photographs of parts of Switzerland and Germany, on the 20th of March.—Adjourned Annual Meeting, March 6th. The President, Mr. W. B. Grove, B.A., in the chair, there was a large and influential attendance of members. Professor Hillhouse, M.A., F.L.S. (the retiring President), delivered an interesting address on the "Present and Future of Science Teaching in England, with special reference to Botany." A discussion followed, in which the President, Messrs. W. R. Hughes, F.L.S., R. W. Chase, J. Levick, J. Cullis, A. Browett, and T. H. Waller took part, and a hearty vote of thanks was accorded to Professor Hillhouse for his able and far-reaching address.—Biological Section, March 13th. Mr. R. W. Chase in the chair. Mr. J. E. Bagnall exhibited *Equisetum sylvaticum* var. *capillare*, from Shirley, Derbyshire; *Lastrea dilatata* var. *dumetorum*, from Kerry; *L. dilatata* var. *collina*, from Pembridge; *L. spinulosum* var. *exaltum*, from Bishopwood, and several other rare ferns. Also, from Mr. F. T. Mott, a beautiful series of the various forms of the common shepherd's purse, *Capsella Bursa-Pastoris*, from Leicester; for Mr. G. C. Druce, F.L.S., *Eriophorum Capitatum* and *E. alpinum*, from St. Moritz, Helvetia; and from Rev. D. C. O. Adams, *Campylopus brevifolius*, a rare moss, from near Bournemouth. Mr. J. Levick called attention to the high price recently given for a great auk's egg, which elicited from the President, Mr. R. W. Chase, a great amount of interesting matter on the subject, which he promised to give in greater detail at some future meeting. Mr. W. B. Grove, B.A., then gave his paper "On New and Noteworthy Fungi, Part IV." This paper abounded in truly interesting and instructive matter, and was ably illustrated by specimens and beautifully executed drawings. A discussion followed, in which the President, and Messrs. J. E. Bagnall, J. Levick, and W. P. Marshall took part.

VOLITION.

BY CONSTANCE C. W. NADEN.

(*Continued from page 57.*)

Now, let us turn to voluntary actions; to those actions which are immediately preceded or accompanied by a concious mental effort in their own direction. These evidently must depend on the cerebral centres, since no other centre conducts its operations consciously. Whether any other centre conducts its operations with effort is another question, which I shall touch presently.

Volitional actions are of two kinds — *initiatory* and *inhibitory*. The initiatory may give the signal for the beginning of a series of automatic actions. For instance, the first step in starting for a walk is volitional, but the effort is slight and does not require to be maintained. Or the action initiated may have been performed rarely or never before, and then the initiatory effort has to come in at every stage. The action may be physical or purely mental; it may be learning to dance or learning a foreign language, or applying muscular or intellectual energy to any kind of labour or study. In the same way, inhibitory volitions may concern thoughts or things; we may try to refrain from some reflection, or from some deed.

Every voluntary action, whether initiatory or inhibitory, is preceded by or bound up with an act of attention, which is itself volitional, and both initiates by turning the mind in its own direction, and inhibits by suppressing tendencies in other directions. Wundt, in his "Physiological Psychology," compares *apperception*, the product of attention, to the *point* of distinct vision, while simple perception, which follows upon mere inattentive sensation, corresponds to the entire *field* of vision. He says "Apperception is the primitive voluntary action, the performance of which is always presupposed in the external voluntary actions. The condition necessary for the execution of a voluntary movement is the apperception of the representation of that movement." He points out that our own feelings inform us of the state of nervous tension—accompanying that state of consciousness called attention, and constituting its physical side. It should be added, however, that even attention may be unaccompanied by any sense of effort, and thus, according to our definition of volition, may be called involuntary. This may be due to automatism, as when the subject is familiar; or due to impulse, as when the

subject is strongly fascinating; or to a mixture of the two. The novel-reader is conscious of no effort of attention when absorbed in some delightful work of fiction; but set him down to a scientific treatise, and his sense of effort may come little short of headache.

By the aid of an ingenious apparatus called Hipp's chronoscope, Hersch, and subsequently Wundt, have been able to measure the time required for a voluntary response to any given stimulus; this time of response averages from $\frac{1}{8}$th to $\frac{1}{5}$th of a second, and decreases with the increased energy of the stimulus; and, by subtracting the time taken up in nervous transmission to and from the brain, Wundt obtains the duration of the three processes of perception, apperception, and volition. These processes, which he calls "psycho-physical," usually require a much longer time than the purely physiological processes of transmission. But, if, by means of a preparatory signal, the observer is led to *expect* the stimulus at a given instant, the psycho-physical stage may be greatly shortened, and may even be reduced to zero, so that the response takes no longer than a simple reflex action. Or the response may even be simultaneous with the stimulus. Wundt explains these phenomena in the following manner:—When the preparatory nervous tension has attained its highest point, the prepared movement can no longer be restrained, and the nerve-energy overflows into action, so that we respond to an irritation from within, instead of to a stimulus from without. Thus the apperception and the responsive volition no longer constitute two stages, but are fused into one act of will.

I now return to the consideration of the two classes of volitions; initiatory and inhibitory.

The distinguishing quality of initiatory volitions is that they are non-automatic. They cannot be predicted; and even when considered as responses to simple stimuli, they are liable to indefinite variation, dependent on the constantly varying condition of the cells of the cerebral cortex. Therefore, the machinery of volition has, as it were, to be readjusted every time it comes into action, and its responses cannot be made without a certain effort. Yet volitions, like impulses, avail themselves of automatic mechanism, and in return strengthen that mechanism. For when the action is once started volitionally, it very frequently proceeds automatically, as in the already-cited case of setting out to walk; indeed, all our voluntary actions are to some extent intermingled with automatic elements, otherwise life would be intolerably difficult, and progress impossible. We can speak, because

we have learned to speak; read, because we have learned to read; dress ourselves, because we have learned to dress ourselves; that is, because in each case a mechanism has been gradually constructed, which needs only a touch to set it going. This touch—the volition—is really of the nature of an *impulse*, and can be distinguished from impulse only by its inferior strength, or by the superiority of the obstacles that stand in its path. It is an impulse either intrinsically feeble or strongly opposed. Often two volitions conflict, causing a painful mental struggle; often volition and automatism conflict, the volition trying to turn the thoughts from a habitual channel, and not succeeding unless it be so strong and energetic as to merit the name of impulse, or unless the counter-channel be well-worn. Will has little or no effect on the *primary* automatic actions, such as coughing, or irritation of the larynx, heart-beating, the contraction of the iris; because their channels are better worn than the channels of any secondary automatic actions can possibly be.

But how can a volition be truly *inhibitory?* If a volition be a comparatively faint impulse, how can it ever overcome a powerful impulse? It must be remembered here that everything hinges on that word "comparatively," and that if a strong initiatory volition is opposed to an impulse of moderate strength, the sense of effort may be transferred to the impulsive side, which then, by our definition, becomes volitional. But an inhibitory volition seems usually to be a mixture of impulse and automatism, in which automatism preponderates. An effort of will is generally powerless to restrain the expression of emotion, unless there is an ingrained *habit* of self-restraint; a habit which may be inherited, or may have been born of *impulse* of some rival emotion, as fear or love. This is acknowledged in the common phrase—"the triumph of principle over passion."

The impulse to be inhibited may be powerful, and yet may be neutralised by a comparatively faint counter-impulse setting at work the moral machinery.

Among a number of similar cases related by Dr. Maudsley in the "Pathology of Mind" is the following:—"On several occasions I have been consulted by a married lady, the mother of several children, who is afflicted with recurring impulses to kill her youngest children, of whom she is most fond; she cannot bear sometimes to be in the room with them when there are knives on the table and no one else is present; and she is driven to retire to her bedroom, where she weeps in an agony of despair, because of what she calls her wicked thoughts, and prays frantically to be delivered

from them." Here the emotions, and the whole force of moral automatism, were enlisted against the insane impulse, which thus seemed not a part of the character—not, so to speak, a part of the self—but a wicked suggestion from without.

The subject, perhaps, will be clearer if we study the nature of initiation and inhibition in the lower centres. Even the spinal cord can originate; as we learn from that well-known brainless frog, who when a spot of acid is dropped on the inner surface of his thigh, will try to rub it off with the foot of the same leg, and if this foot be cut off, will use the other. Mr. Lewes tells us that it is not every frog who hits on this expedient, for sometimes a frog will bend its body towards the injured leg, "so as to permit the spot to be rubbed against the flank." A brainless animal can even *learn* to execute combined movements; that is, actions which, if conscious, would be called volitional now become automatic in the ordinary sense of that term. "There is," says Freuberg, "a decided improvement acquired in the reactions of the motor-centres after divisions of the spinal cord, not indeed in vigour, but in delicacy. Removed from the regulating influence of the brain, the legs acquire through practice a power of self-regulation." *

These are examples of that wonderful power of self-adaptation to the environment, which is not confined to nervous tissue, but is manifested even by the lowest organisms, at least as regards the absorption and assimilation of food, and is shown by higher animals not only in their voluntary actions, but in their organic functions, and in the phenomena of acclimatisation, possibly also in other phenomena, not completely explicable by the Natural Selection hypothesis. Indeed, this power of organised tissues may perhaps be regarded rather as a condition than as a product of Natural Selection. Could we discover all its conditions, even self-adaptation might reveal itself as automatic, although depending on adjustments so delicate as to transcend all ordinary conceptions of automatism. But to return to the pithed frog.

The self-adaptation of the spinal cord is not volitional, because not conscious; but, since it involves a *variation* of the habitual course of action, it corresponds with volition on the objective or physiological side. The only difference is, that the sense of conscious effort, or the subjective side of volition, is absent. Initiatory volitions, then, have their counterpart in the functions of the spinal cord.

* Quoted in "Physical Basis of Mind."

As regards inhibitory volitions, the correspondence is even more marked. Mr. Lewes states as follows what he calls the "Laws of Discharge and Arrest":—"The simultaneous influence of several stimuli, each of which excites the same centre, is cumulative; stimuli then assist each other, and their resultant is their *arithmetical* sum. Simultaneous stimuli, each of which excites a different centre, *interfere* with each other's energy, and their resultant is their algebraical sum."* Thus, a reflex action may be inhibited by the stimulation of a sensory nerve, even when the cerebrum is removed. In a frog from which the hemispheres have been taken, stimulation of the optic lobes and optic thalami delays the reflex action; and a like effect is produced by stimulation of any afferent nerve. "If the foreleg of a headless frog be irritated, the hind leg will also be moved by the stimulation, or *vice versâ*. Here, then, has been a propagation of the excitation in either direction. But if while the legs are thus irritated, and the centres are ready to discharge, another and more powerful irritation reach the centre—say by pinching the skin of the back—there will be no discharge along the legs."† In these and similar instances it is evident that inhibition may take place either because the opposing stimulus is the stronger, or because the path for the action which it initiates is better worn, though doubtless the latter case occurs more frequently in the higher and less completely mechanised centres than in the lower ones.

I have now completed my attempt to answer the question with which this paper began—"What is a voluntary action?" —and have only to sum up results. I have tried to show that actions may be classified as "automatic" and "impulsive"; the former being characterised by definiteness, the latter by variability, and hence apparent spontaneity. There is no separate physiological class of "voluntary" action, although in the regions of psychology, such a class may still be admitted. Such actions always seem in a peculiar sense our own, and, as we say, the product of our own free will, because the sense of effort which distinguishes them brings more prominently into consciousness the *mental* factor, as opposed to the mere stimulus, which, in effortless automatic and impulsive actions, seems to carry all before it.

As Dr. Johnson said, "We feel we are free, and there's an end on't"—or, if we are not willing that there should be such a summary end, we must content ourselves with the knowledge that our actions are free in the only intelligible

* "Physical Basis of Mind," Problem II., ch. viii.

† Ibid.

meaning of the word; that is, they flow from the laws of our own nature. The impulses of insanity and intoxication seem to over-ride these laws, and in a certain sense do over-ride them, by deranging the functions of the brain; thus the drunkard or the madman is no longer, during his paroxysms, a free agent. His actions do not flow from the laws of his nature, so much as from the laws of his disease.

In speaking of the "Will," we have to guard against the natural assumption that the same word always means the same thing. What do we mean, for instance, when we speak of a man of strong Will? Sometimes we mean that he is a man of strong Impulses, who dominates and tyrannises over others by the force of his passions. But his Volitions—the conscious efforts of his mind—may be few. Or again, we may mean that he is a man of strong Principles; that his trains of thought and moral feeling are definitely organised, so that his moral nature acts automatically. But in this case, if there are few Impulses needing to be inhibited, there will be few Volitions.

A man of Will, then, is not necessarily a man of Volition.

THE PRESENT AND FUTURE OF SCIENCE TEACHING IN ENGLAND;

WITH SPECIAL REFERENCE TO BOTANY.

Address to the Birmingham Natural History and Microscopical Society, as Retiring President, by

W. HILLHOUSE, M.A., F.L.S.

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(Continued from page 86.)

The difficulties in the way of the systematic teaching of science in schools belong to one of several heads. Perhaps the most important of these is the *historical difficulty*. The educational system of an old country is not constructed; it has grown. In our relations with institutions in the general body politic we constantly come across this method of reasoning:—"Were we to formulate a brand new constitution such and such a thing would find no place in it. It is there now merely because it has been there in the past. It has no other *raison d'être*. Does not logic demand, therefore, its removal." But I do not think we can fully appreciate the historical difficulty merely by thus looking at matters. That which has grown up in a nation's life is not like a rock

lying in the middle of a road, demanding only to be removed. Every change, of whatsoever kind, creates a certain amount of social disturbance, which in itself may be harmful, and the true thinker has not to balance only the profit of the new against the profit of the old, but has to reckon in his balance-sheet in some way or other with the disturbance which has been created, and the cost of making the change. Just as when the manufacturer may for years and years go on manufacturing his particular type of goods by means of machinery which is manifestly old-fashioned and comparatively ineffective, when other machinery may be in existence by which the same work is much better done, the unthinking are apt to jeer. But the manufacturer cannot simply compare his profits under the old with those under the new system ; a vital factor in his calculation must be the cost of reconstruction. Unless the new process will recompense for this it is truer economy to go on in the old way.

We cannot fully realise the condition of educational matters in England without duly considering the fact that until only, so to speak, the other day nearly all the education that was worthy of the name lay in the hands of the old educational foundations of this country. The methods of teaching, the subjects taught, were white with the snow of centuries. In many cases even the founder's will strictly defined the nature of the bulk of the curriculum, and the schoolmaster was fettered more or less closely by chains forged at a time when education had barely escaped from the monopoly of the priesthood and the bar. With generation after generation, generation after generation, trained upon the same narrow lines, we can feel no sense of surprise that the schoolmaster's curriculum became surrounded with a halo of mystic reverence, and that he who ventured to touch it even with his thoughts should be deemed iconoclastic. It is true that educational reformers came and went; the name of Arnold alone might stand in evidence of this. But the educational reformer of the past dealt rather with the methods than with the subjects of education. Can we be surprised then that even to-day, with the modern spirit working strongly within us for years, the fine old crusted "liberal education" of our grandsires should only have been shaken, should hardly have been reconstructed. It is as hard for the leopard to change his spots as for the older type of educationalist to change his conviction that the Alpha and Omega of a liberal education are summed up in the two words "Latin" and "Greek." A new generation has sprung up, but of them it cannot be said that they "knew not Joseph." They are the field in which is being, and has to be, fought out the

battle of the old principles and the new. We have grown up imbued with the new gospel of education; it is ours to carry that gospel one step further on, and hand it to our successors still more fully impregnated with the spirit of the new life.

The second great difficulty in the way of the thorough teaching of science in schools is *Ignorance*. I do not by this mean ignorance in the crudest sense of the word. I mean ignorance of the objects and realities of scientific knowledge, ignorance of what its acquisition may lead to. In many minds such ignorance is closely allied to dread. The teaching of Greek and Latin lend stability to the national constitution; the teaching of physical and biological science is revolutionary and may unsettle the foundations of our state and our religion. I cannot but acknowledge that there is some small apology for this feeling. Exponents of science have not been at all times sufficiently careful to distinguish between the proven and the problematical; and some brilliant hypothesis which scientists themselves take for what it is, and no more than it is, may serve to shock and frighten off a whole army of semi-converts, while it heightens the distrust of the totally unconverted. Now we have no more right to expect that the man of science should clip the wings of his Pegasus, and linger solely on this solid earth, than we have to ask that a Milton should restrict his daring irreverence, and deal solely with the clay of our common humanity. But in our teaching we are, I think, justified in asking more. To carry into practical effect the famous dictum of Wordsworth, the king of the school of poets of Cosmos—

> "To the solid ground
> Of Nature trusts the mind that builds for aye;"—

we are justified in asking that in our teaching we shall distinguish between the known and the unknown; we are not justified in teaching to children as known that which is only hypothecated; we are not justified in teaching a doctrine before the nature of the evidence on which that doctrine is based can be understood, appreciated, and weighed. You will see, then, in effect we are here carrying out the principle of one of the greatest of educational reformers, Pestalozzi, that children should not so much be taught as shown how to find out things for themselves. A child will not find out a doctrine, but a child can find out portions of the evidence on which a doctrine is based.

Having now somewhat cleared the way, we are in a position to go further into this subject of science teaching in schools. If there is anything upon which as a nation we

pride ourselves, it is on being a "practical people." The "practical man" is a great factor in our public and also in our educational life. Nor can we affect surprise at this. Your practical man has usually very clear ideas; they may be limited, but they are not indistinct. He sees his way marked out before him, and follows it unerringly. The chances are he has attained wealth, and nowhere is wealth more deified than here. The man who has attained his own ends so successfully must surely be the man to strike out the best path for others. All this is very plausible, and hence the practical man largely has his own way.*

Now, I do not hesitate, as an educationalist, to say that, in matters of education, the so-called practical man is a grave danger. It is true that he, in common with all teachers, looks upon education as a means of fitting the youngster for the battle of life. He says the youngster will have such and such things to do hereafter; fit him for them. But if he had his way entirely, his "fitted" youngster would be but a machine. "Oh," he says, "what's the good of teaching him so and so? Teach him something that will be useful," for your practical man is nothing if he is not utilitarian. To the practical man we owe all that is unhealthy in the current demand for technical education. To him the boy is simply a machine to do work of some kind or other, and every extra wheel or band beyond those that are necessary detract from the value of the machine.

But is this an ideal of education? God forbid that this earth should be peopled by piece workers without a thought or hope beyond their tiny sphere of labour. How much better is his than the ignorance of the countryman, whose soul's loftiest flights never carry him out of reach of the aroma of his pig-stye? No, I cannot help thinking that in our craving for the useful, we risk losing sight of the educational. Without forgetting other principles, ought we to throw away what surely is the most fundamental of all, that the value of a subject for educational purposes should be gauged by its educational value? It sounds almost like a

* That I may not be mistaken as to the sort of man I refer to, let me quote from the "Arabian Nights," Lane's Edition, 1877, Vol. I., p. 141. The Second Royal Mendicant, describes how, having been robbed of all he possessed, he found himself destitute in the city of his father's greatest enemy. A kindly tailor takes pity on him, feeds and clothes him, and then asks him: "Dost thou not know any trade by which to make gain?" I answered, "I am acquainted with the law, a student of sciences, a writer, and an arithmetician." "Thy occupation," he said, "is profitless in our country; *there is no one in our city acquainted with science or writing, but only with getting money.*"

truism to say this; yet let us ask ourselves what it means. Does it not mean this, that a child is born into the world with a certain range of faculties and powers—physical, intellectual, and moral. If these faculties are neglected they will lie in abeyance, be gradually deadened, ultimately lost. The true duty of education is to take each and all of these faculties, neglecting no one of them, and to cultivate them to the greatest attainable height of perfection. Those subjects are of the greatest educational importance which, effort for effort, produce the greatest educational results. "Give me a fact, sir," says the practical man. "Give me a thought," says the true educationalist. As I have said elsewhere*—"To use the power of thought and reasoning, this is a prime factor in true education; and I would rather have a man who thinks wrongly than one who does not think at all. There is hope for the one, none for the other. Once get principles and reasons well grounded and the facts marshal themselves. Facts without reasons are like a fleet of vessels without crews, capable of no concerted and intelligent action, but nevertheless readily capable of mutual destruction."

I think the child himself teaches us the true method of education. How delighted at the discovery of something new, how receptive of impressions, how quick in attempting generalisations,—probably inaccurate, but none the less educational for that. It is only when you come to crush the child's life into things that it does not and cannot understand or appreciate, that its brightness becomes dulled, its receptiveness deadened. The child has taught you the grand educational principle that observation is the first phase of intellectual education.

And here it appears to me that the special value of science in education comes in, viz., that all sciences are based on observation, and, if there be any truth in our preliminaries, that branch of science which is most provocative of observation should hold pre-eminence in early educational training. I cannot help, therefore, venturing to think that the handiwork of the "practical man" is to be seen in the comparative monopoly of school scientific education by Chemistry and Physics. I do not wish to say one word against the importance of either of these subjects; but what I mean is this. The practical man sees that Chemistry, for example, has brought about great economic results, by which much wealth has accrued to the nation, and, therefore, by one of those intellectual efforts peculiar to him, imagines that it must be

* Pharmaceutical Conference, 1886; see "Pharmaceutical Journal," Sept. 18, p. 237 *et seq.*

the best subject to teach to children! But if we are to adopt our standard of educational merit, Chemistry must take a place, as an educational subject, certainly not at the top of the experimental sciences.

One last thought, and I have done with this part of my subject. What do we do for the training of the eyes of our children? Next to nothing. It is true, and from the very nature of the case, that the eyes are in constant use, but this is not what I mean. What the eyes require is systematic training, so as to produce the ability to use them with minute accuracy and with rapidity, Give a piece of very accurate work to the ordinary artizan, and you will find by bitter experience that, what with "rule of thumb" and "near enough," those two great curses of our artizan population, your chances of an accurate result are small indeed. We shall never recover our vanishing position in the industrial world until accurate correlation of eye and hand are an essential part of our educational system, and for this purpose drawing, and one of the biological sciences—sciences purely of observation and experiment—and that, preferably, Botany, as the one most suited for school teaching, should, if properly taught, be found of inestimable value. I ought, however, to restrict here my application of the term Botany to that which to botanists is known as "Morphological" botany; for physiological botany, the knowledge of the life-history of plants, dependent as it so largely is upon a prior physical and chemical training, could find a place only in the latest stages of the schoolboy's career, if at all. I have no sympathy whatever with the mere teaching of scientific facts; with the observation of those facts I have abundant sympathy.

As scientific method is, in all cases, practically like, it may facilitate my task if I refer for one moment to this. Four stages are to be recognised in this method: (1) *Observation*, whether of natural phenomena, or of results brought about by experiment; (2) *Classification*, or the arrangement, by comparative methods, of the results of observation; (3) *Deduction*, that is inferences drawn from observed phenomena and hence application to unknown things; and (4) *Verification*, that is, the process whereby the accuracy of our conclusions is tested. Now as far as school purposes are concerned, I make bold to believe that no branch of science whatever approaches in value in all of these respects to the study with the fuller teaching of which my life is occupied, or rather to that portion of it which we call systematic and morphological botany; and, as the four steps in scientific method noted above represent with tolerable accuracy also four stages in the evolution of the mental power

of man, observation is naturally that which should first be taught. And in this highly artificial and crowded town life of ours, so fraught with evil—social, moral, physical, and intellectual,—it is of more than ordinary importance that the child shall have its life so attuned as to vibrate with ease to the touch of natural beauty, that it shall have every inducement placed in its way to forsake the crowded streets and alleys, the drawing-room and the study as well as the gin palace and the beershop, and seek by contact with Nature in the fields and lanes, the hills and the valleys, fresh inspiration wherewith to charm the drudgery of its daily toil for bread.

(*To be continued.*)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 95.*)

"The Midland Medical and Surgical Reporter and Topographical and Statistical Journal" was published in Worcester from 1828 to 1832. It is in the Worcester Public Library, and has been examined for me by Mr. Towndrow. Three volumes only appeared: Vol. I., 1828-29; Vol. II., 1830-31; Vol. III., 1831-32. The first volume only contains any matter germane to the Botany of the County of Worcester.

No. 1 (August, 1828) contains an essay on the "Medical Topography of Worcestershire," which appears, however, to be restricted to the neighbourhood of Malvern. The author, whose name is not given, states that "specimens of Genista anglica, Ononis arvensis, Ulex europæus and nanus (*Gallii*) are scattered about the hills; but, excepting the Grasses, the Ferns are by far the most abundant plants, filling the valleys, while the Dwarf Fern (*Polypodium vulgare?*) gives a green covering to the rocks; the Viola tricolor flowers in abundance." He further remarks that "the plants which seem to have claimed these hills as their own, are the Digitalis purpurea, of which a white variety is often met with, and the Hyoscyamus niger, very abundant on the North Hill." appearing whenever the soil is disturbed. The author next gives a short list of plants, copied in the main from previous writers, as obvious errors are repeated, but containing, *inter alia*, Acer campestris and Acer Pseudo-platanus. He concludes by saying that "in some parts of the Hilly Limestone country we occasionally meet with the Potentilla verna, more particularly in the neighbourhood of Malvern. Some of the

rarer species of Orchis are also found in the Limestone hills, as Orchis ustulata on the Abberley Hill."

Vol. I., No. 2, the number for November, 1828, contains, p. 100-105, an essay entitled "Some Observations on the Coal District of Worcestershire, and on the Botanical and other Peculiarities of the Malvern Hills," by J. K. Walker, M.D., Huddersfield. After some general remarks on the vegetation of the Malvern Hills, the writer says:—Your last number enumerates some of the rarer plants growing here, to which I beg to add the following list, according to the specimens now lying before me. They were all collected between three or four miles of the Holywell:—

‡ **Papaver.** (*No species mentioned.*)
* **Chelidonium majus.**
* **Fumaria** (*Corydalis*) **claviculata.**
* **Reseda Luteola.**
* **Cistus Helianthemum** (*Helianthemum Chamæcistus*).
‡ **Polygala vulgaris.**

It is doubtful whether this is P. vulgaris or P. depressa.

Silene inflata.	‡ **Senecio** (2 species).
Lychnis Flos-cuculi.	**Solidago Virg-aurea.**
Spergula arvensis.	**Campanula rotundifolia.**
Arenaria (*Spergularia*) **rubra.**	* **C. patula.**
* **Hypericum perforatum.**	* **Chironia** (*Erythræa*) **Centaurium.**
* **H. humifusum.**	* **Chlora perfoliata.**
H. pulchrum.	* **Verbascum Th.** (*probably Thapsus*).
H. hirsutum.	**Scrophularia nodosa.**
* **H. montanum.**	* **Digitalis purpurea.**
* **Malva moschata.**	* **Antirrhinum Linaria** (*L. vulgaris*).
* **M. rotundifolia.**	* **Veronica serpyllifolia.**
Geranium pusillum.	* **V. Chamædrys.**
G. Robertianum.	* **V. Anagallis.**
Oxalis Acetosella.	* **V. Beccabunga.**
Lotus corniculatus.	* **Euphrasia officinalis.**
Vicia Cracca.	**Rhinanthus** (*Crista-galli*).
V. sepium.	* **Verbena officinalis.**
V. sativa.	* **Thymus Serpyllum.**
Lathyrus pratensis.	* **Glechoma hederacea.**
Spiræa Ulmaria.	* **Marrubium vulgare.**
* **Agrimonia Eupatoria.**	**Betonica officinalis.**
* **Sanguisorba officinalis.**	**Galeopsis Ladanum.**
Geum urbanum.	* **Teucrium Scorodonia.**
* **Sedum album.**	† **Myosotis.** (*No species mentioned*
* **Cotyledon Umbilicus.**	* **Cynoglossum officinale.**
* **Galium verum.**	**Anagallis arvensis.**
* **Scabiosa succisa.**	**Euphorbia Peplus.**

S. arvensis.
* Pyrethrum Parthenium.
Achillea Millefolium.
† Gnaphalium luteo-album. *Must be an error.*
Humulus Lupulus.
* Tamus communis.

The first two numbers of the "Reporter" appeared in the same year, 1828, as Wm. Ainsworth's list in the Edinburgh Philosophical Journal. I am uncertain which of the two is entitled to precedence. The anonymous author in August, 1828, gives Ulex europæus and Ononis arvensis, also noted by Ainsworth; J. K. Walker, in November, 1828, gives Helianthemum Chamæcistus (*H. vulgare, Gaert*) and Campanula rotundifolia, also noted by Ainsworth.

Spergularia rubra, Hypericum pulchrum, Geranium pusillum, Spiræa Ulmaria, Solidago Virg-aurea, Betonica officinalis, in Mr. Walker's list, take precedence of the same plants in Mr. Lees's list in Loudon's Magazine, 1830.

Geranium Robertianum, Anagallis arvensis, Humulus Lupulus, take precedence of the same plants in Scott.

The 2nd number of the "Reporter" contains at p. 105, the following interesting note on the Atropa Belladonna, by James Nash, M.D., Worcester:—

"I beg leave to state . . . . . that the Belladonna has grown and flourished upon an old wall, formed of broken pieces of red sandstone and iron dross, in the village of Lincomb, in the parish of Hartlebury, ever since the recollection of the principal inhabitants, and I have no doubt of its genuine wildness."

A serial, entitled "The Worcestershire Miscellany," edited by Mr. Edwin Lees, was published at intervals from March, 1829, to March, 1830. Five numbers only appeared, which were afterwards collected and a supplement and preface added in 1831. A few plants from the Malvern Hills and the following plants from Perry Wood, near Worcester, are noticed in the first number:—

* Rhamnus catharticus.
* Lathyrus sylvestris.
* Wild Cherry (*Prunus Avium*).
* Rosa spinosissima.
* R. Borreri.
* Pyrus torminalis.
P. communis.
P. Malus.
* Circæa lutetiana.
Serratula tinctoria.
* Campanula patula.
* Melampyrum vulgatum (*pratense*).
* Daphne Laureola.
Betula alba.
Populus tremula.

Serratula tinctoria and Populus tremula take precedence of the records in Scott.

Cochlearia groenlandica, mentioned among the Malvern plants, as growing on a marshy tract, somewhere on the North Hill, is probably an error, as it is not acknowledged in the "Botany of Worcestershire."

The "Illustrations of the Natural History of Worcestershire," by the late Sir Charles Hastings, M.D., published in 1834, contains an introductory lecture delivered by him to the Worcestershire Natural History Society, an account of the proceedings at the first anniversary meeting of the Society, held on the 16th May, 1834, and several appendices. Among the latter are: Appendix C, a "Catalogue of some of the rarer Lepidopterous Insects found in Worcestershire," and Appendix D, a "Catalogue of some of the most remarkable and interesting plants indigenous to Worcestershire, with their habitats," both the work of Mr. Edwin Lees. The last mentioned Catalogue, pp. 147-180, contains notices of the principal authorities for the Botany of the County, and a list of 888 species, with their habitats. Many of these are old records by Nash, Stokes, Withering, Purton, and Scott. Others were supplied by contemporary botanists, among whom Dr. Streeten, a physician then practising in Worcester, was a large contributor. Mr. Lees's own name is affixed to many of the records. As to the remainder, which are vouched by no authority, it is not always easy to tell whether they are given on that of Mr. Lees himself or are reproductions from other writers. In many instances the former is certainly the case, in other instances, almost certainly the latter. Perry's list appears to have escaped Mr. Lees's attention. Some Hereford and Gloucester records are included, without any notice that they do not belong to Worcester.

In the following reprint of the Catalogue I have omitted all the species given only on the authority of earlier writers. The plants previously noted by Mr. Lees in the Strangers' Guide are marked with the letters S.G.; those in Loudon's Magazine by the letters L.M.

Edwin Lees, in Hastings's "Illustrations of the Natural History of Worcestershire," 1834:—

* **Clematis Vitalba**, 167. Abundant about Ankerdine Hill and Malvern. Also in the hedges at Powick.

* **Thalictrum flavum**, 167. Eastern side of Pitchcroft, banks of the Severn, &c.

* **Ranunculus Lingua**, 167. The late Mr. T. B. Stretch, a Worcester botanist, records having found it in Ockerley (*Ockeridge*) Wood, Holt. S.G.

* **R. parviflorus**, 167. Under hedges by the road side, near the Virgin's Tavern, Worcester. Also at Hallow, Cotheridge, Alfrick, and Malvern, in considerable plenty. L.M.

† **Trollius europæus**, 167. Moist meadows at the foot of Bredon Hill. *Must be an error. The species is not noticed in Mr. E. Lees's Botany of Worcestershire, 1867.*

* **Aquilegia vulgaris**, 167. In Bewdley Forest, Shrawley Wood, and about Leigh Sinton. The smaller variety, A. alpina, of Hudson, on Bromsgrove Lickey. Dr. Streeten. S.G. *Aquilegia alpina, Linn., is mentioned by Hudson as growing in Westmoreland. Fl. Ang., 1st Ed., p. 208; 2nd Ed., p. 235. Dr. Streeten must have been mistaken in referring the Lickey plant to this species. The Columbine has not been seen at the Lickey for many years.* L.M.

* **Delphinium Consolida** (*D. Ajacis*), 167. Near Grimley. Mr. Edmunds.

Berberis vulgaris, 160. In a hedge by the side of Comer Lane.

Nymphæa alba, 166. In the Avon, under Littleton Bank, according to Mrs. George Perrott.

* **Nuphar lutea**, 166. Abundant in the tributaries of the Avon, and in various brooks and pools.

* **Papaver somniferum**, 166. Severn side below Worcester Bridge. S.G.

* **Fumaria** (*Corydalis*) **lutea**, 171. Found by Mr. Lees in a shady lane below Abberley Church, not in the immediate vicinity of any garden, but probably naturalised.

* **F.** (*Corydalis*) **claviculata**, 171. Abundant among the loose stones on the declivities of the Malvern Hills. L.M.

* **F. capreolata**, 171. In a hedge at Shrawley and near Abberley.

* **Cardamine amara**, 170. Below Worcester, in a willowy spot at the Ketch, close to the Severn. Mr. Lees. S.G.

* **C. impatiens**, 170. Western side of the Severn, below Worcester Bridge. Also in Shrawley Wood and on Rosebury Rock.

* **Nasturtium sylvestre**, 170. On the banks of the Severn, at Worcester, most abundantly.

* **N. amphibium**, 170. In ditches by the side of Pitchcroft.

* **Turritis glabra**, 171. Near an old sandstone quarry between the Mitre Oak and Stourport. Messrs. Walcot and Lees.

Cochlearia Armoracia, 169. On the banks of the Severn, truly wild.

Alyssum maritimum, 169. Once found growing on the west bank of the Severn, below Worcester bridge, by Mr. James Goodman.

* **Teesdalia nudicaulis**, 169. Abundant on Hartlebury Common, and at the Giant's Grave, Habberley. Mr. Lees.

* **Reseda Luteola**, 164. In waste places about Grimley, Leigh Sinton, &c. Growing luxuriantly on a wall bounding Angel Street Cemetery, Worcester.

* **Cistus Helianthemum**, 167. (*Helianthemum Chamæcistus, Mill.*) Abundant on the Malvern Hills and Bredon Hill. Also on dry banks at Alfrick, Clifton-on-Teme, Crowle, &c. L.M.

Viola palustris, 155. On Hartlebury Common.

V. hirta, 155. Lane leading from Kempsey to Green Street. Dr. Streeten.

* **Drosera rotundifolia**, 159. Bog at the base of the Worcestershire Beacon, Malvern. Hartlebury Common, Bromsgrove Lickey. L.M.

(To be continued.)

MR. HERBERT SPENCER.—This distinguished philosopher completed his 68th year on Friday, 27th April last, having been born at Derby in 1820. At a meeting of the Sociological section of the Birmingham Natural History and Microscopical Society, held on Tuesday, 24th April, on the motion of Mr. W. B. Grove, B.A., President of the Society, seconded by Mr. W. R. Hughes, F.L.S., President of the section, a resolution of congratulation was unanimously passed on the occasion, and Mr. F. G. Cullis. F.G.S., the Hon. Secretary, was requested to communicate it to Mr. Spencer.

A NEW ILLUSTRATED MANUAL OF BRITISH BIRDS.*

It gives us much pleasure to draw attention to a new book about British birds, which, so far as the first part enables us to judge, will supply a long felt want. It is to be issued in about twenty monthly shilling parts, each containing forty pages and twenty illustrations. The latter will be mostly the same as the wood cuts in the fourth edition of "Yarrell's British Birds," the general excellence of which is so well known as to render praise of them quite superfluous. When completed the volume will contain nearly 800 pages, and will provide a convenient illustrated hand-book, embodying concise descriptions of the geographical distribution, habits, nesting, plumage, and in fact all other needful information, which can be compressed into the allotted space, of all our British birds. Two pages will be given to each species, inclusive of the illustrations, of which there will be more than 350. The author is Mr. Howard Saunders, F.L.S., F.Z.S., editor of the third and fourth volumes of the last (fourth) edition of "Yarrell's British Birds." This book promises to be of great use to young ornithologists, and will, we do not doubt, find a place in the libraries of all who desire to possess a reliable book about British birds, but who cannot afford to buy the more costly books, which, until now, have been the only ones on the subject worth possessing. To enable our readers to judge for themselves, we subjoin one of the descriptive articles from the first part, with its illustration, for the use of which we are indebted to the courtesy of the publishers. We warmly recommend this new manual to all who are interested in ornithology:—

* "An Illustrated Manual of British Birds," by Howard Saunders, F.L.S., F.Z.S., &c. In monthly parts. Price 1s. London: Gurney and Jackson (successors to Mr. Van Voorst).

THE MISSEL-THRUSH.
TURDUS VISCÍVORUS, Linnæus.

"The Missel-Thrush, the largest indigenous species of the genus, has, owing to the increase of plantations during the present century, extended its breeding-range northward to Caithness and Sutherland, and to most of the Hebrides; though to the Orkneys it is only a straggler, and has not yet been recorded from the Shetlands. Unknown in Ireland until about the year 1800, it is now a resident and increasing species there; while in England and Wales it is of general distribution, being commoner in the wooded districts. Migration takes place from the colder portions of our islands in autumn and winter, when large flocks arrive from the Continent.

It breeds from Bodö in Norway southward, throughout the suitable portions of temperate Europe to the extremity of the Spanish Peninsula, and even in Northern Africa; eastward, in Turkey, the Caucasus, the mountain forests of Asia Minor, Turkestan, and the north-western Himalayas up to 9,000 feet: in the latter it attains its palest colour and largest dimensions, and was formerly distinguished as *T. Hodgsoni*. In temperate Siberia it is found eastward to Lake Baikal; migrating in winter to Northern India, Persia, and Africa north of the Sahara.

In the south of England the Missel-Thrush sometimes begins to breed in February, and even in the north it frequently has eggs in March. The nest, which when placed in a wide fork of a tree has a considerable foundation of mud, is lined with dry grasses and composed

externally of bents and lichens, but although the colour of the latter may resemble that of the branch on which the structure is placed—bushes being seldom resorted to—there is often no attempt at concealment. The eggs, 4-5 in number, are greenish to tawny-white, blotched with reddish-brown and lilac: measurements about 1·25 in. by ·85 in. In the south two broods are generally produced annually, but in the north the fine weather is too short for more than one. From its habit of singing early in the year in defiance of rough weather, the Missel-Thrush is often called the 'Storm-cock'; also the 'Holm-screech,' from its partiality to the berries of the Holm or Holly, and its harsh *churr*-ing note. Its trivial name is probably a contraction of Mistletoe-Thrush, owing to a widely-spread belief in its predilection for the berries of that parasite; but in Great Britain its food consists rather of berries of the yew, holly, mountain-ash, hawthorn, ivy, &c., fruit when obtainable, worms, snails and insects. Although shy of man, except when its nest is approached, the Missel-Thrush is bold and tyrannical towards other birds, fearlessly attacking Magpies, Jays, and other species superior to it in size; and occasionally it has even been known to carry off nestlings. Its flight is rapid but jerky, and on the wing its large size and generally *grey* appearance serve to distinguish it from any other Thrushes.

Adult male: upper parts ash-brown; under parts buffish-white, with bold fan-shaped spots, smaller and more arrow-shaped on the throat; under wing-coverts and axillaries pure white; bill horn-brown, yellowish at the base; legs pale brown. Length about 11in.; wing from the carpal joint 5·75in. The female is slightly paler than the male. In the young the arrow-shaped markings on the throat and breast are more pronounced; the upper wing-coverts broadly tipped with white, and the under parts, especially the flanks, suffused with golden-buff. In this plumage it has been mistaken for the rare White's Thrush, but its *twelve* tail-feathers distinguish it."

THE FLORA OF WEST YORKSHIRE.*

"The Flora of West Yorkshire" has been long looked for; and the high botanical reputation of its author, together with the peculiar features of the district whose flora it records, have given rise to expectations of something more than ordinary. It is not saying too much to say that in the work before us these expectations are fully realised, nor is it flattery to say that it is one of the completest and most ably compiled of our local floras. Like Purton's classic "Midland Flora," it embraces the whole range of systematic botany, from the conspicuous phanerogam to the little known and less heeded diatom. It has, however, an advantage over "The Midland Flora" in not being an attempt of one mind to grasp and work out a number of diverse and difficult branches of botanical science, but in each of the special groups, such as mosses, lichens, fungi, &c., Dr. Lees has had the able help of specialists; hence each branch has been well worked and fully

* "The Flora of West Yorkshire," by F. Arnold Lees, M.R.C.S. Eng. 8vo. Lovell Reeve and Co., pp. 843. Coloured map of the district.

recorded, and the names of the recorders are a sufficient guarantee for the correctness of the record. After some introductory remarks under the title of "Foreword," the work opens with a well-written chapter on "Climatology," treating of many and varied subjects in connection therewith, such as, position as affecting climate, aerial temperature in the Riding, atmospheric humidity and rainfall, winds, temperature in relation to vegetation, climatic and botanic zones, limits and areas of the four West Yorkshire zones, and zonal range of West Yorkshire flora, all of which are ably and fully discussed, the altitude above sea level of many of the districts being given, together with many tables in illustration. This chapter closes with a table giving the altitudinal limitations in West Yorkshire for 420 selected species of the ascending group from 150 feet to 2,400 feet, and some interesting observations on the Genesis of the flora. The chapter is full of instructive interest to both botanist and general student.

The next chapter, "Lithology," which treats of the rocks and soils, and their influence on the flora of the West Riding, is well written and thoughtfully worked out, and gives abundant evidence of close and attentive study, not only of the physical features of West Yorkshire, but also of the published works of other writers, such as Thurmann and J. G. Baker, as well as of the excellent floras of Middlesex and Hants. The following are the headings of the leading paragraphs:—1. Two Great Rock Types. 2. Physical Characters of the Hills of Each Type. 3. Lithological Classification of Soils. 4. Comparisons between Thurmann's List and the Flora of West Yorkshire. 5. Botanical Features of West Yorkshire Soils. 7. Geographical Allies. A very full bibliography of the flora follows, giving data from 1548 to 1885; the introductory matter concluding with the Plan of the Flora, which gives full explanations of the classification and details of that portion of the volume.

The flora proper then follows. That devoted to flowering plants and ferns occupies 410 pages. The nomenclature and classification is mainly that of the 7th edition of the "London Catalogue of British Plants," though here and again a slight departure is made. The English name, where such exists, follows the botanical or Latin name, and, what is more interesting, we have, so far as these are known, rustic names, and these are often very expressive.

That the older authors have been carefully studied is seen by frequent quotations from their works. The quotations are fully given and the synonyms special to each author quoted. Many other details are given, such as range, upward or downward, in feet above sea level; the degree of citizenship,

such as native, casual, denizen, colonist, and the like, and followed in many instances by those pleasant critical observations which mark the work of a real student and true lover of his subject.

The Characeæ are arranged in accordance with the excellent monograph of Messrs. H. and J. Groves, and here we have records of 12 out of the 25 British species—a very full and complete list.

Bryophyta, which follows, includes a record of all the mosses and hepatics of the West Riding. This occupies 97 pages, and is probably the most extensive and complete record yet published of any British district. Among the recorders are some well-known names, such as W. Wilson, J. Nowell, J. G. Baker, and Messrs. West. Hobkirk, Slater, Barnes, Stabler, Carrington, Spruce, and Pearsal, so that some of the ablest and most reliable workers in this field of study have aided in producing this portion of the flora; hence its fulness. The only plant one misses is *Pterigynandrum filiforme*, which the writer certainly observed in Bolton Wood. The total number of mosses and hepatics recorded is 448.

The Lichens occupy twenty-nine pages, and give a record of 258 species. The classification and nomenclature is that of Leighton's "Lichen Flora of Great Britain." In these plants the records are mainly from Dr. Carrington, J. G. Baker, Bohler, West, and Stansfield. This study is one of minutiæ, and requires closer investigation than most other botanical studies, hence we rarely find these plants as fully recorded as in the case of mosses, and the more conspicuous cryptogams; the district, however, seems to have been well worked, and the record is a good one.

Fungi occupy eighty pages and give a record of 1,009 species, of which 488 belong to the Hymenomycetes. Although the records of these plants date back to James Bolton, whose "History of Funguses" is now classic, and known by reputation throughout the world, little seems to have been done in the West Riding since his day, until some seven years ago the first Fungus Foray ever held in Yorkshire gave an impetus to the study. So that, while the "History of Funguses" gives the kernel to the Fungus florula, it is the work of enthusiasts during the past seven years that has supplied the main material, and the record does them great credit. Following this is the Fresh Water Algæ, revised by William West, the arrangement being that of Dr. Cooke in his recently published "British Fresh Water Algæ," this occupies thirty-two pages, and records 382 species, including the diatoms.

A copious Addenda and Omissa, which occupies thirty-seven pages, closes the work, and the following summary will show at a glance how rich a field for research is to be found in the West Riding of Yorkshire. These are:—

Phanerogams (including Ferns) ...	1,044
Characeæ	12
Mosses	340
Hepatics	108
Lichens	258
Fungi	1,009
Algæ	382
	3,153

There are three ably compiled indices, the work of Mr. W. Whitwell. These are excellent, and reflect well on the patience and thoroughness of the compiler.

In conclusion, the work is well printed, and, considering the vastness of the records, remarkably free from errata, and from beginning to end reflects the highest credit on the author.

J. E. Bagnall.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

In publishing this list of the Fungi of Warwickshire, our aim has been to place on record all that has been done by past and present workers in the study of the Warwickshire Hymenomycetes, so far as our knowledge extends.

The list must be far from complete, as only portions of the county have been worked, and those portions far from exhaustively.

In determining the species intended by Withering and Purton, the identifications of previous authors have not been copied; but an attempt has been made, by comparison of their descriptions, and the quoted figures, with the latest ideas of Fries, to decide what was meant by them, and we feel assured that this can be satisfactorily done in more cases than has been before imagined.

We have also availed ourselves of that extensive series of coloured illustrations of fungi from the neighbourhood of Kenilworth and Warwick which is now in the British Museum; these were executed by the late Mrs. Russell, of Kenilworth, and many of her specimens were named or confirmed by eminent authorities. We must here acknowledge our indebtedness to the late Rev. W. W. Newbould for all our

knowledge of the nomenclature and stations given on these plates. He, with kindly courtesy, and the untiring patience so peculiarly his own, without solicitation on our part, copied for us all the details we give from these. Of present workers we have to thank the Rev. D. C. O. Adams for his numerous MS. notes on the fungi found by him in the neighbourhood of Combe, Ansty, and Brinklow; Dr. M. C. Cooke for notes made during his various visits to Birmingham, and also for other kind and valuable help; and, besides him, Messrs. C. B. Plowright, M.R.C.S., of King's Lynn, and Mr. W. Phillips, of Shrewsbury. In quoting our various authorities want of space has prevented our giving the full names of our authorities or titles of works referred to, and the following will show what these abbreviations indicate:—

With.—An arrangement of British Plants. By William Withering, M.D., F.R.S. The Fungi in Volume IV., Ed. 4, 1801. Ed. 7, 1830. Unless otherwise stated, Ed. 4 is the one intended.

Purt.—A Botanical description of British Plants in the Midland Counties. By Thomas Purton, Surgeon, Alcester. Vol. II., 1817.
An appendix to the Midland Flora, 1821.

Bloxam.—Manuscript notes by the late Rev. Andrew Bloxam, of Twycross, in his copy of the 5th volume of English Flora in our possession.

Russell, Illustr.—A series of coloured Illustrations of the Fungi around Kenilworth and Warwick. By the late Mrs. Russell, of Kenilworth, now in the British Museum.

Russell, List.—A printed List of the British Fungi, marked by the late Mrs. Russell, lent by her niece, Miss Worsley.

Rugby School Rep.—Report of the Rugby School Natural History Society, 1886.

Adams.—Rev. D. C. O. Adams, M.A., of Ansty, near Coventry. MS. Notes.

Perceval.—List of Fungi found in the neighbourhood of Warwick, between October, 1871, and October, 1872, by Cecil H. S. Perceval, Esq.

Cooke's Illustr.—Illustrations of British Fungi (Hymenomycetes). By Dr. M. C. Cooke.

The mark (!) after any locality denotes that it has been seen by one of us in that same place; the same mark after the name of an authority, that we have seen the specimen referred to.

Order I.—AGARICINI.

Genus I.—AGARICUS.

Sub-genus I.—Amanita.

1. **Ag. phalloides,** *Fr.* *Ag. muscarius*, var. 5, *stramineus*, Purt. Woods and fields. Aug.-Sept. Ragley and Oversley Wood, *Purt.* iii., 208. Kenilworth, *Russell, List.* Warwick, *Perceval.* Combe Ridings! *Adams.*

Pool Hollies Wood, Sutton; Trickley Coppice, and New Park, Middleton; Edgbaston Park; Packington Park; Cut Throat Coppice, Solihull; Crackley Wood, Kenilworth; Haywood; Old Park Wood, Ragley Woods.

Var. *vernus*, Bull. *Ag. muscarius*, var. 3, *albus*, Purt. Woods and heaths, rare, Oversley, *Purt.* iii., 201. Combe Ridings, *Adams.* New Park, Middleton; Marston Green; Coleshill Pool; copse, by Plant's Brook Reservoir.

The plants from Oversley and Marston Green, at least, are probably the *albus* form of *Ag. phalloides.*

2. **Ag. Mappa,** *Fr.* Woods, &c. Sept.-Oct. Rare. Birmingham Road, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* Sutton Park; Trickley Coppice; Shawberry Wood, Shustoke.
3. **Ag. muscarius,** *L.* Woods and heathy footways, Aug.-Sept. Frequent. Edgbaston! *With.*, 182. Oversley Wood, *Purt.* ii., 680. Crackley Wood, *Russell, Illustr.*, Combe Woods; Allesley; *Adams.* Oscott College Grounds; Trickley Coppice, and New Park, Middleton; Sutton Park; Langley; Coleshill Heath; Marston Green; Edgbaston Park; Shustoke.

   Var. *puella.* *Ag. muscarius*, var. 4, *Purt.* Ragley Woods, *Purt.* iii., 202. Trickley Coppice. Sometimes as large as type.
4. **Ag. pantherinus,** *DC.* *Ag. muscarius*, var. 2, Purt., *ex part.* Oversley Hill; Coughton Park; *Purt.* iii., 201. Sutton Park; the Spring, Kenilworth; Alveston Pastures.
5. **Ag. excelsus,** *Fr.* Woods. Kenilworth, *Russell, List.*
6. **Ag. rubescens,** *Pers.* *Ag. muscarius*, var. 7, *With.* Woods and open places. Common. Edgbaston Park, where grass had been mown, *With.*, 183. Crackley Wood, *Russell, Illustr.* High Wood, Combe, *Adams.* Warwick, *Perceval.* Sutton Park; New Park, Middleton; Bradnock's Hayes, near Sutton; Ham's Hall; pine wood, near Coleshill; Coleshill Pool; Packington Park; Marston Green; Hampton-in-Arden; Solihull; Knowle; Kingswood; Berkswell; the Spring, Kenilworth; Ragley Park.
7. **Ag. nitidus,** *Fr.* Woods. Rare. Sept.-Oct. Coleshill Pool. *Ag. muscarius*, var. 2, *With.*, 182, Edgbaston, is either this or *Ag. Mappa.*
8. **Ag. asper,** *Fr.* Woods. Aug.-Oct. Rare. Crackley Wood? Birmingham Road, Kenilworth? *Russell, Illustr.* Sutton Park? Packington Park; Coleshill Pool; Shepherd's Wood, near Solihull.

9. **Ag. vaginatus,** *Bull.* (*Ag. muscarius*, var. 6, *plumbeus*. With., Purt.) Woods and pastures. Common. Sept.-Oct. Pastures, Edgbaston; Edgbaston Park! *With.*, 240, 268, Wood, near Pophills, *Mrs. Rufford*, Purt. iii., 208. Kenilworth! *Russell, List.* Ansty, *Adams.* Sutton Park; Windley Pool, Four Oaks; Trickley Coppice; Middleton; pine wood, near Coleshill; Coleshill Pool, Water Orton; Ham's Hall; Marston Green; Haywood; Ragley Wood; Arrow; Alveston Pastures.

The varieties *fulvus* and *lividus* both occur, the former more commonly and usually smaller.

Ag. strangulatus, *Fr.* A single specimen, probably belonging to this species, has occurred at Ham's Hall.

(*To be continued.*)

THE MIDLAND UNION OF NATURAL HISTORY AND MICROSCOPICAL SOCIETIES.

The arrangements for the Annual Meeting at Northampton are in an unusually advanced state, and we are able to give our readers an outline of the proposals of the host society, the Northamptonshire Natural History Society and Field Club, as submitted to the Executive Committee of the Union at a meeting on Wednesday, April 25th. The date fixed for the Annual Meeting is Wednesday and Thursday, July 4th and 5th. The Right Hon. Earl Spencer will be President, the Annual Meeting itself being held in the Town Hall at the usual time on Wednesday afternoon. The address, in place of one by the President, will be delivered by the Rev. H. H. Slater, F.Z.S., the well-known ornithologist, upon some ornithological subject not at present fixed. After the meeting there will be a party to visit the principal Churches of Northampton, conducted by the Rev. T. C. Beasley, Secretary of the Architectural Society of Northampton, and in the evening there will be a conversazione in the Town Hall. Arrangements have been made to hold this in conjunction with the annual meeting of the Northampton Architectural Society, and papers will be read by C. A. Markham, Esq., Sir Henry Dryden, and others. On this first day of the meeting a luncheon will be provided for the Council, members of the Union, &c., in the middle of the day.

On Thursday there will be three excursions. (1) The members of the Union will be permitted to join the annual excursion of the Northampton Architectural Society, under the leadership of Sir Henry Dryden, to the most famous Churches of the neighbourhood; (2) a Geological excursion, visiting some

of the sections in the neighbourhood of Northampton, specially including the Upper Lias, Inferior and Great Oolite, &c.; (3) a Botanical excursion to Fawsley Park, Badby Woods, and Daventry, in the course of which it is hoped to visit the grounds of E. G. Loder, Esq., including his famous Alpine and Winter Gardens, &c.

Further particulars of these arrangements will be given hereafter, but enough has been said to show that Northampton has determined to improve upon the high reputation it acquired during the last visit of the Union.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, March 20th. Mr. T. H. Waller, B.A., B.Sc., in the chair; forty-three members and friends present. Professor Hillhouse exhibited two examples of Antipodal Culture of Hyacinths, consisting of four bulbs planted in vases; two bulbs in each vase, one erect at the top, the other inverted towards the bottom. The bottom bulb in each case had grown downwards into the water, and one had flowered in the water. Mr. Chas. Pumphrey exhibited, by the oxy-hydrogen lantern, a fine series of photographic views (geological and others), taken by himself in parts of Switzerland and Germany, including Dover Cliffs, Falls of the Rhine, The Rigi, "The Catastrophe at Zug," Valley of Engelberg, Engelberg Water Falls, Brünig Pass, Upper and Lower Glaciers of the Grindelwald, the Wetterhorn, and many others of considerable interest and beauty. A cordial vote of thanks was given to Mr. Pumphrey for his kindness in exhibiting these views and so clearly describing them.—BIOLOGICAL SECTION MEETING, held April 10. Mr. R. W. Chase, F.L.S., in the chair. The following were exhibited by Mr. W. H. Wilkinson:—A collection of Lichens, from South Devon, including the rare *Parmelia acetabulum*, rare *Lecanora ferruginea*, *L. parella*, *Lecidea canescens*, *Placodium murorum*, &c. By Mr. W. B. Grove, B.A.—Fungi: *Peziza nivea* and the rare *Triposporium elegans*, both from Hopwood Dingle. By J. E. Bagnall, A.L.S., a number of Mosses, Hepatics, and Lichens, from the Warwickshire Stour Valley, including *Orthotrichum cupulatum* and *Didymodon sinuosus*, both new to the district, and *Orthotrichum obtusifolium*, *Cryphæa heteromalla*, rare, &c.; for Fred. Enock, F.E.S., a series of fourteen sketches of insect preparations, No. 11. being specially noticeable. This is a longitudinal section through a fully grown impregnated garden spider, *Epeïra diadema*, showing all the organs which lie in the line of section, an instructive as well as most beautiful preparation. Mr. W. P. Marshall having taken the chair, Mr. R. W. Chase then gave his paper, "Notes upon Birds which have become extinct, and those species which are likely to become so in Great Britain; illustrated by a series of Photographs of Eggs of the Great Auk, *Alca impennis*." This paper was one of great interest, and was illustrated by life-size photographs of most of the existing eggs of the species, seventy-seven in number, all being kindly lent for the occasion by Mr. E. Bidwell; also by clutches of eggs of allied species, and specimens of the Razor Bill and Small

Auk. A discussion followed, which was ably sustained by Mr. G. A. Panton, F.R.S.E., who gave much interesting information from personal knowledge; also by Mr. W. P. Marshall, and Mr. W. H. Wilkinson. Mr. Chase's paper will be published in due course in the "Midland Naturalist."—SOCIOLOGICAL SECTION. At the ordinary meeting on Tuesday, January 24th, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Mr. A. Browett on the eleventh and twelfth chapters of Mr. Herbert Spencer's "Data of Ethics," viz.:—"Egoism *versus* Altruism" and "Altruism *versus* Egoism." On the proposition of Mr. Browett, seconded by Mr. W. B. Grove, B.A., Mr. W. R. Hughes, F.L.S., was re-elected President of the section, and Mr. F. J. Cullis, Hon. Sec.—At a supplementary meeting, Thursday, February 18th, Mr. W. R. Hughes, F.L.S., in the chair, the Hon. Sec., Mr. F. J. Cullis, continued the reading of Mr. Herbert Spencer's essay on "The Genesis of Science."—At the ordinary meeting, Tuesday, February 28th, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Mr. W. K. Parkes on the thirteenth and fourteenth chapters of Mr. Spencer's "Data of Ethics," entitled respectively "Trial" and "Compromise," and fourteen members were present.—At a supplementary meeting, Thursday, March 1st, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by Professor Allen on Mr. Herbert Spencer's essay on the "Origin and Function of Music," contrasting the views of Mr. Spencer with those of Mr. C. Gurney, illustrating his positions by the use of a piano and a series of tuning forks. An animated discussion followed, in which the President, Mr. Stockley, Mr. Allison, Mr. W. B. Grove, B.A., and Mr. Cullis took part. There were twenty-six members and friends present. The proceedings terminated with a hearty vote of thanks to Professor Allen.—At a supplementary meeting, Thurdsay, March 22nd, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read by the President, opening the study of Mr. Herbert Spencer's "First Principles," after which he read and discussed the first chapter on "Religion and Science."—At the ordinary meeting, Tuesday, March 27th, Mr. J. Levick in the chair, a paper was read by Mr. W. K. Parkes on the last two chapters of Mr. Herbert Spencer's "Data of Ethics," treating of "Absolute and Relative Ethics," and "The Scope of Ethics."—At a supplementary meeting, Thursday, April 5th, Mr. W. R. Hughes, F.L.S., in the chair, a paper was read on the second and third chapters of Mr. Herbert Spencer's "First Principles," dealing with "Ultimate Religious Ideas" and "Ultimate Scientific Ideas."—At a further supplementary meeting, Thursday, April 19th, Mr. W. R. Hughes, F.L.S., in the chair, an exposition of the fourth chapter of Mr. Herbert Spencer's "First Principles" was given by Mr. W. B. Grove, B.A., entitled the "Relativity of all Knowledge." Eleven members were present.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 20th. Special: Geology. Mr. J. Moore exhibited specimens of Trilobites, Ammonites, etc., from the Cambridge Greensand; Mr. J. Collins, specimens of *Limnæa peregra* from an Irish peat bog, thirty feet from the surface, apparently identical with present forms; Mr. Corbet, a collection of minerals and ores from North Wales; Mr. Madison, fossils from the Tertiary beds, Isle of Wight; Mr. A. T. Evans, fossiliferous pebbles from the Drift, and a pebble of spherulitic rhyolite from the same deposit. Under the microscope Mr. J. W. Neville showed a section of Arran Pitchstone; Mr. H. Hawkes, conceptacle of *Fucus serratus* and other algæ.—February 27th.

Mr. C. P. Neville exhibited marine shells from Sydney; Mr. J. Madison, specimens of *Bulimus detritus* from Switzerland; Mr. Camm, *Trichina spiralis* in rat's tongue. Then followed a paper on "A Conchological Ramble in South Wales." The ramble was from Caermarthen up the country to the lakes in the Black Mountains, on the border of Brecknockshire, to search one of the lakes, Llyn-van-fach, for specimens of *Limnæa peregra* var. *Burnetti*, said to be found there. The route was described and the various shells met with on the way, and the position and scenery of the lakes and their surroundings with the shells found in them. The journey was a successful one and yielded specimens of the shell sought. The return was made by way of Swansea. The shells collected in the ramble were exhibited.—March 5th. Mr. Bennett showed differently coloured sands from Alum Bay, Isle of Wight. Under the microscope, Mr. Camm, *Carchesium polypinum*; Mr. J. W. Neville exhibited foraminifera from Jersey, and called attention to the resemblance they bore in form and texture to those derived from the Cambridgeshire silt.—March 12th. A lime-light lantern exhibition of natural history objects. The President in the chair. The President showed a series of photographs of rock sections, pointing out the various inclusions in rocks and how such inclusions arose; Mr. J. W. Neville, a series of illustrations of Rhizopods, Rotifers, and Polyzoa; Mr. O. Hutchinson, photo-micrographs of rocks, sections, and diatomaceæ; Mr. W. Tylar, rural scenery, hedgerows, frost effects, etc.; Mr. Delicate, photographs of the rocks and caverns of the Wren's Nest; Mr. C. Pumphrey, photographs of flowers; Mr. J. Edmonds, photographs of animal and vegetable tissues, illustrations of pond life, and some miscellaneous views.—March 19th. Subject: "Object Mounting and Section Cutting." Mr. Delicate gave some useful hints on the mounting of animal and vegetable tissues in Deane's gelatine. Mr. H. Hawkes described the usefulness of glycerine as a mounting medium, and the class of objects best adapted for it. The chief difficulty in its use was in the ringing, but this had been overcome by the use of gum damar dissolved in benzoline, instead of the usual gold size. Mr. J. W. Neville described the preparation and mounting of insects in balsam. A collection of slides was exhibited to illustrate each process.—March 26th. Mr J. Edmonds gave a lecture on "Photo-Micrography Simplified." The speaker said his object was not so much to show the best way of accomplishing the end in view as the simplest and least expensive one. Though the visual and actinic rays of light did not focus exactly on the same plane, yet in practice he had found an ordinary microscopic object glass capable of producing good pictures. The camera was dispensed with, and the image formed by an object glass fixed in the microscope stand thrown on a moveable screen. The simplicity of the arrangement was much admired. During the evening a negative was taken that gave every satisfaction, and showed how readily a microscopist could produce permanent records of his studies.—April 9th. Mr. J. W. Neville exhibited specimens of *Trinucleus concentricus*, a trilobite from the Mid-Bala shales; Mr. Deakin, a collection of fossils from the fluvio-marine beds of the Eocene formation, Isle of Wight; Mr. Hopkins, specimens of *Helix aspersa*, showing umbilicus; Mr. J. Collins, specimens of *Ostrea expansa* and other fossils from Portland; Mr. Hawkes, a collection of marine algæ, including specimens of *Ptilota elegans*, with tetraspores and *Sphærococcus coronopifolius*. Under the microscopes Mr. Hawkes showed a series of preparations of algæ; Mr. J. Collins, *Ceramium nodosum*.

THE PRESENT AND FUTURE OF SCIENCE TEACHING IN ENGLAND; WITH SPECIAL REFERENCE TO BOTANY.

ADDRESS TO THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY, AS RETIRING PRESIDENT, BY

W. HILLHOUSE, M.A., F.L.S.

(PROFESSOR OF BOTANY AND VEGETABLE PHYSIOLOGY, MASON SCIENCE COLLEGE, BIRMINGHAM).

(Continued from page 120.)

But time warns me that I must pass away from the school, in order briefly to consider the position of affairs in higher teaching; here, however, confining my attention mainly to the subject of Botany.

From a botanical point of view the last fifteen years or so, so fraught with great results in our national education movement, are specially marked by three important changes. The first of these is the rise of a new subject of education, or rather of a systematic combination of portions of three old subjects, to which the name of "Biology" is given. Professor Huxley, who must be looked upon as the founder of this new teaching, thus explains his position in the preface to his "Course in Practical Biology," 1875:—"I arrived at the conviction that the study of living bodies is really one discipline, which is divided into Zoology and Botany simply as a matter of convenience, and that the scientific zoologist should no more be ignorant of the fundamental phenomena of vegetable life, than the scientific botanist of those of animal existence." Again, more recently (November, 1887), in a new edition of the same work, he says:—"No man can be competent to deal with the greater problems of Biology as they are now presented to us, unless he has made a survey, at once conprehensive and thorough, of the whole field of biological investigation. The animal and the vegetable world are only two aspects of the same fundamental series of phenomena, and each is capable of throwing a flood of light upon the other." This assertion of the unity of life is, I venture to think, one of the greatest features of Huxley's life work. Biology, as taught by Professor Huxley, consisted in the successive study, structural and functional, of a small number of selected plants and animals, used as "types." Commencing with yeast and *Protococcus* on the one hand, and *Amœba* on the other, as illustrating some of the simplest phases of plant and animal life respectively, it progressed by greater

or lesser jumps to the fern and bean plant on the one side, and the frog on the other. I do not now express any opinion as to the relative advantages and disadvantages of this method of type-teaching, nor is it easy to come to any definite conclusion thereon at all, although I systematically practise both methods of teaching.

The second of the great changes is the enormous amplification in the scope of botanical teaching, due, there can be no doubt, to the publication of the "Lehrbuch der Botanik" of Professor Sachs, in 1872, and its translation into English in 1875. It is well-nigh impossible to estimate at its due value the influence of this grand work upon the formation of the modern school of English botanists. From it the teaching of Cambridge took its inspiration, and to Cambridge four-fifths of the teachers of the new school owe their training.

The third change referred to is the gradual decadence, and final excision, of Botany, as a subject essential to the training of every medical man. This change, which has come into operation for the conjoint Colleges of Physicians and Surgeons of London, and the Universities of Cambridge and London,—the largest medical examining bodies in the kingdom,—has been due largely to the desire to contract the scope of the student's work, and partly to more strictly scientific reasons, since in the Universities of Cambridge and of London "Biology" has replaced it as an examination subject. With this alteration, *per se*, I have here, of course, nothing to do, but I must in passing be allowed to touch upon one or two principles which I think ought clearly to underlie the training for any such profession as that of medicine. It must be borne in mind that the medical man has rights and powers conferred upon him by statute; that the life, health, and, in some degree also, the reputation of his patient are entrusted to him, and that the patient cannot reasonably be expected to accurately gauge the extent of his professional adviser's ability. He has, in fact, largely to be taken on the faith of what examinations and the statute represent him to be. The public, then, has a right to demand that no misplaced leniency shall turn adrift upon it men who have not been tested in the most stringent manner. The work of the doctor cannot be tested like the work of the carpenter; the fact of being a medical man should carry with it its own evidence of skill. Further, the medical man differs from the quack only in that his methods are scientific and not empirical, and the public, therefore, has a right to ask that his education shall be based upon the soundest possible scientific training; and that, as his profession is not chemical

or physical but biological, so Biology should form an inherent and all important part of his preliminary training. The third of my principles is this:—In any education spreading over a term of years, including a series of steps, each of which has to be successfully taken before arriving at a definite and necessary goal, the weeding, if it has to be done at all, should be done on the very threshold. It is cruel kindness to allow a student to pass the earlier grades easily, because they are not so technically important, and then, after perhaps three or four years, to stop his career and compel him to start life afresh, and handicapped by several years of age. If this is permitted, too, it serves as a constant temptation to the soft-hearted examiner (and, in spite of the probable personal experience of every one of us, examiners can be soft-hearted) to forget his duty to the public by passing through the ultimate gates of the profession men of whose scientific competency he has doubts. I know that all the pecuniary inducements of examining bodies, and the system of composition fees, are against the adoption of the course I urge, but on that account so much the more necessary does it appear to urge it.

Side by side with these changes in the aspects of scientific teaching has progressed that remarkable outburst of belief in the need of the higher scientific education and of faith in its efficacy, which has found expression in the establishment of a series of local colleges of lofty and far-reaching purpose, within the walls of one of which we hold this meeting; and upon these colleges the first of the changes to which I have referred, namely, the creation of a new conjoint field of study under the name of Biology, has had a remarkable effect. But fully to understand the nature of this it is necessary to point out that not merely did Professor Huxley believe in the unity of the subject, but, though probably not from belief, he practised the unity of the teaching; in other words, he himself conducted the whole of the teaching, botanical and zoological alike. The result of this is to be easily found in the nature of the teaching. Huxley is a zoologist. Rather less than one-third of the space, and very considerably less than one-third of the time, in this conjoint course is devoted to the botanical side of the subject, while of the types selected, though some are admirable, others are selected rather for their ease in acquisition than for their suitability as types, and the "jumps" are far too great. The other great biological teacher of the decade, Dr. Michael Foster, followed at Cambridge on much the same lines. Here, again, the teaching was done entirely by zoologists or zoo-physiologists,

and, most admirable though I can from my own experience attest it to have been both in matter and in method, it cannot be stated to have fairly included representatives of the vegetable kingdom. Now in Cambridge this did not act altogether disadvantageously, since Botany was there taught as a subject by itself by specialists of renown, who were able by their own force of character and inherent ability to hold their own. But what its effect would be in the country at large, and in the formation of the new local colleges, would not need the eye of a major prophet to determine.

Before 1870, two great metropolitan colleges, those of University and King's, and one provincial college, Owens at Manchester, were in existence, and at these the old distribution of the teaching power, modified by the improved nature of the teaching, naturally persisted. But what occurred in Birmingham, Bristol, Leeds, Liverpool, Newcastle, Nottingham, and Sheffield, where colleges of the university type one by one came into existence? In each of these, under the name either of Biology or of Natural History, a chair was founded, the primary teaching of which was to be "Biology," with, in the case of Nottingham, Geology thrown in. Of these seven professorships two were filled by geologists, the other five were occupied by zoologists. Thus Biology, instead of being a fair representative of the two sides of life, came, and from a natural sequence of events, to be looked upon as an appanage to Zoology. In some cases a demonstrator was appointed, and it is fair to assume, though this is difficult to verify, that he was in such cases appointed for his botanical qualifications. Now this could not fail to react upon the quality of the teaching; primarily, no doubt, causing the botanical side of Biology to be treated in the most perfunctory manner, for teachers are not all Huxleys and Fosters, and even they, as we have seen, were not free from this; and secondarily, by having their teaching energy frittered away in teaching subjects with which it is no injustice to them to say they were not familiarised, the interests of Zoology itself would come to suffer. Some colleges have not been slow to recognise this. Mason College, Birmingham, divided the chair into two of equivalent importance in less than two years after its opening; in 1886 Liverpool raised its demonstrator of Botany to the rank of a lecturer; while University College, Bristol, which, up to 1887, had had a professor of Zoology and a lecturer in Botany, in that year, as is stated in the calendar, "In consequence of the new regulations for the Intermediate Examinations in Science of the University of London, by which Botany is raised to

co-ordinate importance with Zoology, these two leading divisions of Biology will be treated separately by the lecturers in Botany and Zoology respectively," raised the lecturer in Botany to the rank of professor. The change which is here referred to, whereby the biological curriculum for the first scientific examination of the University of London was greatly enlarged upon its botanical side, was made in the year 1885, concurrently with the replacement of Botany by Biology in the first examinations for the medical degrees.

That the new local colleges have not made their mark in the biological portions of the examinations for London is clear, and mainly, I believe, this is due to the method of teaching adopted. To take a single illustration:—In the scientific examinations for the London Science degrees, up to and including last year, the whole of the above provincial colleges, including Owens College, Manchester, have secured ten honours in Botany, of which five have fallen to Mason College, two to Owens College, two to the Yorkshire College at Leeds, and one to University College, Liverpool; in Zoology the total number has been nineteen: fourteen to Owens, three to Mason College, and one each to Leeds and Liverpool. Thus more than half of the honours secured to the younger provincial colleges have fallen to the college in which the subject of Biology has been taught by two teachers of equal standing and approximately equal facilities; and the quality of the honours obtained but emphasises this statement.

But in the last two or three years two remarkable steps in a part reversion to the *status quo ante* 1875 have been made. One of these has been the withdrawal of Professors Huxley and Michael Foster, in London and Cambridge respectively, from the direct work of teaching "Biology," and in each of these cases, while the subject as such is retained, the teaching has been divided, the botanical and zoological portions being taken by a botanist and zoologist respectively. The second reversion is in its way no less remarkable. The ideal teaching of Biology commenced amongst those simple phases of life in which plant and animal find their common origin, and from that point, as in following up the two arms of a letter V, the two sides of life were followed up, diverging as they went, until in their culminating points they were so remote as to show no surface relationship together. This, too, is now altered, and instead the study is pursued, as philosophically it should be pursued, from the known to the unknown, from the highly developed to the simple. But this it is not difficult to see, alters the whole basis of biological teaching as heretofore understood.

Do not let it be imagined that I am in any way undervaluing the work which Huxley has done in this matter. Besides his inestimable labours in demonstrating to the public the perfect compatibility of "Science and Culture," labours with which the opening day of this Mason College will ever be associated, he has performed three great and peculiar services. He has taught us the unity of life in a way in which it had never been brought home to us before; he has shown us that for teaching, whether botanical or zoological, to be worthy of the name it must be carried out upon a philosophical basis; he has shaken up the dry bones of morphological Zoology and Botany and given a vividness and reality to teaching which it can never again lose. All teaching, whether of Botany or of Zoology, is now placed upon a biological basis more completely, perhaps, than Huxley himself had anticipated, and in England, at least, this is mainly due to his persistent efforts. If I rejoice in the part return to the *status quo* which I have already indicated, it is not from any want of the fullest sympathy with the pith and essence of Huxley's method, but rather from the profound belief that no effective living instruction can be imparted in even the elementary parts of a biological subject, excepting by one who has probed the subject to its inner depths, and that in these days the amplification of knowledge is so rapid that the men are few and far between to whom this is possible in more than one direction; in addition to which I cannot help thinking that the apparently inevitable annexation of chairs of Biology by those whose special bent is zoological, an annexation which is apparent in Wales, in Scotland, in Australia, and New Zealand, just as we have already seen it to be in England, would have been fatally destructive in its effects upon the higher study of my own subject.

There is work enough for the botanical teacher to do. As a science subject for schools, I believe botany to be unrivalled; but it will be incompletely taught if ideas are not implanted in the minds of the children as to the nature and purpose of what they observe, and as to the evident way in which nature and purpose inter-act; and the teachers themselves can only be trained in the lecture room and laboratory of a teaching university, or of some institution akin to Mason College, where a specialist is in charge of the subject. The scientific pursuit of agriculture, a thing well-nigh unknown a few years ago, and not too well known to-day, will depend in some degree at least upon a skilled botanical training, whether for the agricultural students themselves, or for those who are to teach them. For all who, in whatsoever walk in

life, have occasion to make use of the microscope, there exists no finer training ground than a study of the structure of plants. For the pharmaceutical chemist in that new departure which it is their early hope to make, a thorough grounding in botanical science will be a matter of necessity. But above and beyond all these practical and economic applications, there stands the grand educational principle that for those who follow knowledge, not as a means whereby to earn thirteen pence in the time in which a shilling had been earned before, but as a means for the full development of those faculties wherewith God has endowed them, there is no line of study which is profitless, no line of thought which is thrown away. The golden rule of our educational method of the future will, I believe, be not to accumulate information but to cultivate ability; not to cram the brain, but to train and develop the faculties. Knowledge may indeed be power, but intellectual power is more than knowledge.

ERRATUM.—On p. 85, l. 15 from foot, for "less" read "more."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 90.)

V.—WHAT WOULD BE THE EXPENSE?

The matter of expense is not one that I can deal with from personal experience, but it will, nevertheless, be easy to show that the scheme that has been described would be much less expensive than the one recently adopted by the Northampton Town Council.

The particular advantages, in the matter of expense, are detailed below:—

1.—*There would be no reservoir to construct*, for the porous beds of the Marlstone would hold sufficient water for many years of drought.

2.—*There would be no pipes to lay.* A considerable item in most schemes of water supply is the purchase, and laying of pipes for the conveyance of water from the place where it is collected to where it is required;* but here the bed itself forms a sufficient means of communication from place to place.

* In the case of Northampton this is about seven miles.

3.—*No additional pumping station, or apparatus would be required*, at least for the present necessities of the town; for so long as the water levels were kept lower at Northampton than elsewhere, so long would the water chiefly flow to this place.

4.—*No artificial filter beds would be required.* With surface water, such as that obtained from running streams, or from impounding reservoirs, large filter beds have to be constructed and maintained in good condition; the initial expense is considerable, and there is a continuous one afterwards for cleaning. Of the three filters, through which it has been proposed to pass the water used in filling up the Marlstone, viz., the River gravel, Dumb-well, and Marlstone rock, only the well would necessitate expense in construction, and this would require little or no attention afterwards, for well clarified water only would reach it from the river gravel or drains.

5.—*The expense of constructing the dumb-wells* would then be the chief item. Within the area spoken of as suitable for the construction of such wells, none of them would exceed 140 feet in order to reach the lower water-bearing bed, and some of them would be less than this depth. From advice obtained, I do not think the wells themselves would cost more than £250 each, on an average. The highest figure that has been suggested by anybody for them is £1,000. I will accept this latter as the cost of them, not that I believe it possible they might cost this amount, but because it gives a good margin for certain contingencies or further developments, such as making drains to the wells in certain cases, making a communication with the river, or driving a heading to join the two water-bearing beds in case a well should be made on the wrong side of the Nen "fault," &c.

It might be advisable at the outset to carry a heading from the Billing Road well right up to the "fault," which could scarcely be more than 500 yards away, and then make it communicate with the higher water-bearing bed on the southern side of the "fault." Such a heading would aid very much the draining of the Marlstone, constitute in itself a considerable reservoir, and open up a communication with the southern Middle Lias area, which, so far, has yielded us no water. Of course, the supply from the southern area would not be large, because only the lower water-bearing bed comes into the town, but it would be a continuous and useful addition, and the amount would rather increase than diminish with use of the bed, as it has in the case of Messrs. Phipps and Co.'s well.

Naturally the question, whether it would not be better to put down a large number of small borings, instead of making these comparatively large wells, has suggested itself; it has, however, been dismissed on the ground of inefficiency and expense.

6.—*Total Expense.* A scheme which would enable the owners and occupiers of low-lying lands to get rid of much of the water which is now so troublesome ought to have the ready sanction and pecuniary aid of such persons, and, by mutual co-operation, a district greatly improved at comparatively small expense.

It might be that more than twelve wells would be advisable, and that considerable expense would be incurred in procuring the right to construct dumb-wells where most desirable, although they would occupy very little room. For these contingencies allow £18,000, making altogether £25.000, and then the whole scheme would be *one quarter of the expense* now being incurred for the construction of the Ravensthorpe Reservoir, &c., or a saving to the town of at least £75,000.

VI.—Are there any Special Natural or Legal Difficulties in the Matter?

So far as I know, all the *natural difficulties* have been considered; nevertheless, a few observations on some natural and artifical processes, very nearly allied to those proposed, seem to appropriately come here.

I have very naturally been asked where such a plan has been tried. I am not aware that a new idea should not be tried because it has not been tried, and any denunciation founded on such a principle would be satisfactorily answered by saying that it has never failed. I grant that no such plan as this has been adopted, though the principle of swallow holes is well known, and has been recognised and advantageously utilised in numerous instances, as I propose to show.

At a conference on "Water Supply," held by the Society of Arts, at the Health Exhibition, July 24th, 1884, a paper was read by Mr. C. E. De Rance, A.I.C.E., F.G.S., &c. (the Secretary of the Underground Water Committee of the British Association), on "A Possible Increase of Underground Water Supply," in which was proposed, in general terms, the adoption of some such plan as the one under consideration, for all districts where permeable rocks were covered by impermeable. At this meeting the discussion was decidedly

favourable to some such scheme, and some of the observations elicited are recorded below:—

Mr. Conder, C.E., stated that the idea was good and feasible, and that the natural storage places for flood waters were the pervious water-bearing beds.

Mr. Baldwin Latham, C.E., pointed out that in India water was long ago stored in this manner.

General Hyde, of the Indian Railways Department, stated that in Peshawur, the natives have cut channels, in the rainy season, from time immemorial, so as to fill up a gravelly stratum, into which they make their wells through an overlying impervious deposit.

Sir Frederick Abel, C.B., F.R.S., the Chairman of the Conference, commented on the subject, and spoke of its great importance.

Mr. C. E. De Rance, A.I.C.E., F.G.S., has expressed the opinion* that the particular scheme set forth in these pages would succeed.

Until quite recently (January, 1888), I was not aware that anyone had proposed utilizing the river gravels for the storage of water, but I notice—

Professor Prestwich, F.R.S., has suggested† the use of the Thames gravel as a storage reservoir for flood water, whereby the winter water might be conserved, and used to increase the summer flow of the river, by damming back at a narrow part, and conducting it to a lower level down the river in time of drought.

Swallow Holes.

To show that the estimations previously given as to the capacity of artificial swallow holes are not exaggerated, I propose to give now a few instances of the results obtained by some natural and artificial ones.

In Hertfordshire, a number of natural swallow holes bring the rainfall of an isolated clay basin of twenty-three square miles, lying outside the basin of the Lea, to feed the Amwell springs within the Lea basin, long since used by Sir Hugh Middleton to fill the New River.

Clay resting on chalk is sometimes drained by sinking dumb-wells and filling them with flints.

* Northampton Papers, October, 1884.

† "Rainfall and Evaporation," by Symons, Greaves, and Evans. Excerpt Minutes of Proceedings of the Institution of Civil Engineers, 1876.

Mr. Bailey Denton, some years ago, secured the drainage of several hundred acres, on Lord Dillon's estate, in Oxfordshire, by bringing the water to a shaft, three feet in diameter, sunk for twenty to thirty feet in the Oolite, and disposed of the whole of the water.

Mr. W. H. Wheeler, Mem. Inst. C. E., says* that in the Oolitic limestone districts, the waters from ditches may be frequently seen, when running a full stream from eighteen inches to two feet deep, to disappear from the surface, and be absorbed by swallow holes.

Professor Judd, F.R.S., says† that "in the district embraced by sheet 64 of the one-inch Geological Survey Maps, 'Swallow Holes' are very common, the lines of junction of rocks, like the Upper Estuarine Clays and the Lincolnshire Oolite, are often marked by a series of these natural drains, a slight depression in the surface often indicating their position. In some cases the volume of water carried off by means of them is very great, and the roar produced by it in descending is heard at some distance. Smaller swallow holes may often be detected by placing the ear near the surface of the ground." Professor Judd further says:—" These swallow holes are well known to fox hunters, for the long sinuous fissures worn by the constant passage of water through the jointed limestone rocks constitute retreats for foxes, from which it is almost impossible to effect their dislodgment. Doubtless, also the caverns so frequently revealed in the midst of limestone rocks, during quarrying operations, owe their formation to the same agency. In effecting drainage operations, these natural means of carrying off the surface water are often imitated, and artificial swallow holes constructed, and they effect the removal of the *largest volumes* of surface water." Professor Judd gives two or three instances of a whole river disappearing into a porous bed, and re-appearing at the junction with the next impervious one, after flowing for a considerable distance, sometimes several miles: The River Witham, near Thistleton; the River Glen, between Little Bytham and Careby; and the brook which flows by the village of Benefield. Natural swallow holes will only be of common occurrence where the alternating

* "Arterial Drainage and the Storage of Water," by W. H. Wheeler, M.I.C.E., Journal of Royal Agricultural Society, vol. xxvii., part 1. 1878.

† "The Geology of Rutland, and the parts of Lincoln, Leicester, Northampton, Huntingdon, and Cambridge, included on sheet 64," by Jno. W. Judd, F.G.S. Memoirs of Geological Survey.

porous and impervious beds are comparatively thin, and, therefore, they are rare near Northampton, and west of it.

Of instances nearer Northampton than most of those given, I would point to the one at Welton clay pit, already referred to in Part I., where water passed into the Marlstone below, as fast as it could be delivered.

The Northampton sand is very much used as a receptacle for surplus water. Many drains in Northampton have no connection with the culvert, but gratings open on to the rock, and any quantity of water may be got rid of this way.

Limestone pits are sometimes drained by making a hole to the Northampton sand below. The limestone pit at Kingsthorpe was so drained a few years ago, my informant saying, that the water, which had given them so much trouble, was all disposed of in twenty minutes, after making communication with the porous bed below.

THE LEGAL DIFFICULTIES in connection with the carrying out of such a scheme as that proposed in these pages, I must confess, might be considerable, if any use were made of the river, or its feeding streams. The Nen is a remarkable instance of the divided control and jurisdiction which is often so detrimental to permanent improvements in a river course, for there are seventeen different bodies to deal with the riparian and the river interests.

When a stream is running over private ground, the stream is practically private property; it belongs to the riparian proprietor, and in cases where the stream divides two properties, the middle line of the stream is the boundary, but in neither case has the land owner the right to appropriate the water to the detriment of his neighbours. The Nen also is canalised eastward of Northampton, hence an additional difficulty is introduced. To my unlegal mind it does seem strange that opposition should be raised to a plan for relieving the river of surplus water, when it could be well spared, and might otherwise do damage. I do not believe the difficulties in this direction are insuperable; but, supposing they were, the scheme is only to a small extent injured thereby, for there is no similar jurisdiction over underground waters, such as would be chiefly used. An owner of certain lands can appropriate all the water flowing under them, whether it drains his neighbour's wells or not; hence the essential part of the scheme could be carried out by making arrangements with each land proprietor separately, a much easier matter than obtaining the united consent of a number of persons.

(To be continued.)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 133.)

Sub-genus II.—Lepiota.

10. **Ag. procerus,** *Scop.* Woods, pastures, etc. Aug.-Oct. Edgbaston Park! *With.*, 267. The Common, Kenilworth; Stoneleigh Park, *Russell, Illustr.* Bentley Park, 1869, *Bloxam.* Ansty, *Adams.* Pine wood, near Coleshill.
11. **Ag. rachodes,** *Vitt. Ag. procerus*, var. 8, *With.* Pastures. July-Oct. Edgbaston Park, *With.*, 267. Barrow Well Lane, Kenilworth, *Russell, Illustr.* Millfield, Ansty, *Adams.* Warwick Castle Grounds, *Perceval.* Sutton Park, borders of woods; Sutton; Kingswood.
12. **Ag. excoriatus,** *Schæff.* Pastures. July-Sept. *Ag. procerus*, var. 4., *With.* Edgbaston Park, *With.*, 268.
13. **Ag. gracilentus,** *Kromb.* Pastures. Sept. Kenilworth, *Russell, List.*
14. **Ag. acutesquamosus,** *Weinm.* Gardens and hothouses. Rare. Sept.-Oct. Garden at Kenilworth, *Russell, Illustr.* Sutton, on a cucumber bed.
15. **Ag. meleagris,** *Sow.* Greenhouses. Rare. Sept. In pots in greenhouses at Ansty Hall, *Adams.*
16. **Ag. clypeolarius,** *Bull.* Shady places. Rare. Oct. Edgbaston Park, *With.*, 270. In Oversley Lane, leading to the Mill, *Purt.* ii., 650. On the side of Ragley Park, near to Kingley, *Purt.* iii., 421.
17. **Ag. cristatus,** *Fries.* Fields and lawns. Aug.-Oct. Kenilworth, *Russell, List.* Ansty, *Adams.* Sutton Park; Driffold Lane, Sutton, on chips and sawdust. *Ag. clypeolarius*, var. 8, *With.*, 270, is probably this, as he mentions the "disagreeable smell."
18. **Ag. cepæstipes,** *Sow.* Hothouses. Rare. Hothouses, Ansty Hall, *Adams.* Sutton (var. *luteus*), in a forcing house, in great profusion.
19. **Ag. carcharias**. *Pers.* Pine woods. Rather rare. Sept.-Oct. Trickley Coppice, and New Park, Middleton; Water Orton; pine coppice, Coleshill Heath, abundant.
20. **Ag. granulosus,** *Batsch. Ag. croceus*, Purt. Woods, heaths, and footways. Sept.-Oct. Oversley, *Purt.* iii., 405. Bentley Park, 1849, *Bloxam.* The Common, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* Warwick, *Perceval.* Sutton Park; Trickley Coppice and New Park, Middleton; pine wood, Coleshill Heath; Coleshill Bog; Bradnock's Hayes; Hampton; Marston Green.

21. **Ag. amianthinus**, *Scop.* Woods. Rare. Oct. Birmingham Road, Kenilworth, 1871, *Russell, Illustr.*
22. **Ag. polystictus**, *Berk.* Amongst grass by road sides. Rare. Oct. Road sides, amongst grass, and on the Common, Kenilworth, *Russell, Illustr.*

Sub-genus III.—Armillaria.

23. **Ag. melleus**, *Vahl.* *Ag. stipitis*, Sow., With. and Purt. *Ag. cumulatus*, With. On stumps of trees, hedge banks, and woods. Frequent. Aug.-Oct. Alne Hills, *Purt.* ii., 632. Packington Park! *With.*, 189. Edgbaston! *With.*, 187-8. Crackley Wood! Birmingham Road, Kenilworth! *Russell, Illustr.* Ansty, *Adams.* School Close, *Rugby School Rep.* Warwick, *Perceval.* Sutton Park; New Park; Trickley Coppice; Middleton Heath; Coleshill Heath; Arley Wood; Marston Green; Castle Bromwich; Bradnock's Marsh; Solihull; Olton; Kingswood; Haywood; Waverley Wood, Stoneleigh; Oversley Wood; Ragley Wood.
24. **Ag. ramentaceus**, *Bull.* Woods. Rare. Oct. Spinney, near Ansty, *Adams.*

Sub-genus IV.—Tricholoma.

25. **Ag. sejunctus**, *Sow.* Woods. Rare. Sept.-Oct. Burton Green Wood, near Kenilworth, *Russell, Illustr.*
26. **Ag. portentosus**, *Fr.* Wood. Sept.-Nov. Rare. Kenilworth, Nov., 1865, confirmed by Berkeley, *Russell, Illustr.*
27. **Ag. fucatus**, *Fr.* Pine woods. Rare. Crackley Wood! *Russell, Illustr.*
28. **Ag. spermaticus**, *Fr.* Woods. Rare. Sept.-Oct. Shawberry Wood, near Shustoke, 1882. Alveston Pastures, 1882. Confirmed by Dr. Cooke.
29. **Ag. nictitans**, *Fr.* Woods. Sept.-Oct. Local. Pool Hollies Wood, Sutton Park? pine wood, near Coleshill Pool; Plant's Wood; Tile Hill; agreeing with *Cooke's Illustr.*, t. 56.
30. **Ag. flavo-brunneus**, *Fr.* Woods and heaths. Rare. Oct. Windley Pool, Sutton; Coleshill Heath.
31. **Ag. albo-brunneus**, *Pers.* *Ag. viscosus*, Purt. Woods. Oct. Iron Cross, by the side of the turnpike road to Evesham, *Purt.* iii., 208. Trickley Coppice, abundant.
32. **Ag. pessundatus**, *Fr.* Woods. Rare. Sept.-Oct. Among trees, the Spring, Kenilworth, *Russell, Illustr.*
33. **Ag. stans**, *Fr.* Woods. Rare. Oct. Edgbaston Park, amongst trees; agreeing with *Cooke's Illustr.*, t. 198. The two forms mentioned by Fries occurred together.

34. **Ag. rutilans,** *Schaeff.* *Ag. xerampelinus,* With. Woods, amongst pine trees. Local. Oct. Red Rock Plantations, Edgbaston, 6th July, 1791, *With.*, 211. Hopsford, near Ansty, *Adams.* School Close, *Rugby School Rep.* Sutton Park; Coleshill Pool; Barton Green; Kingswood.
35. **Ag. luridus,** *Schaeff.* Woods. Rare. Oct. Crackley Lane, *Russell, Illustr.*
36. **Ag. columbetta,** *Fr.* *Ag. leucocephalus,* With. Woods and pastures. Oct. Rare. Pasture land, Edgbaston, *With.*, 185. Burton Green Wood, *Russell, Illustr.* Combe Ridings, under firs, *Adams.* Coleshill Pool.
Although Withering quotes Bull., t. 536, for his species, it is certainly not *Ag. albus,* Schæff, but agrees closely with the specimens from Coleshill Pool, which were very like *Cooke's illustr.* t. 48.
37. **Ag. scalpturatus,** *Fr.* Woods. Rare. Oct. Burton Green Wood, Oct., 1869, *Russell, Illustr.* High Over, near Combe, *Adams.*
38. **Ag. imbricatus,** *Fr.* Fir woods. Rare. Oct. Abbey Field, *Russell, Illustr.* Trickley Coppice, Oct., 1886.
39. **Ag. vaccinus,** *Pers.* Pine woods. Oct. Kenilworth, *Russell, List.* Combe Ridings, *Adams.* Sutton Park; Crackley Wood.
Withering's plant, from Edgbaston Park (p. 196), is probably *Ag. imbricatus.*
40. **Ag. terreus,** *Schaeff.* Woods. Rare. Aug.-Oct. Edgbaston Park, *With.*, 183. Plantations at Arrow in great plenty, *Purt.* ii., 630. Kenilworth, *Russell, List.* Waldegrave-on-Sow, *Adams.* Sutton Park.
Var. *argyraceus,* Bull. Ansty, 1886, *Adams.*
41. **Ag. saponaceus,** *Fr.* Woods. Local. Sept.-Oct. Kingswood, *Hawkes!* Upper Holly Hurst, Sutton Park; Trickley Coppice; pine wood, Coleshill Heath; Alveston Pastures.
42. **Ag. cuneifolius,** *Fr.* Fields and near woods. Rare. Sept.-Oct. Abbey Fields, Kenilworth, *Russell, Illustr.* Sutton Park; New Park, Middleton.
43. **Ag. murinaceus,** *Bull.* Rare. Oct. Roadside bank, by Combe Park, *Adams.*
44. **Ag. virgatus,** *Fr.* Woods. Rare. Oct. Edgbaston Park; Coleshill Pool.
45. **Ag. sulphureus,** *Bull.* Woods. Sept.-Oct. Oversley Wood, *Purt.* ii., 628, Crackley Wood, *Russell, Illustr.* Combe Ridings, *Adams.*
46. **Ag. inamoenus,** *Fr.* Very rare. Sutton Park. Odour very unpleasant.

47. **Ag. gambosus,** *Fr.* Pastures. Rare. Warwick, *Perceval.* Ansty, near Coventry, *Adams.*
48. **Ag. albus,** *Schæff.* Rare. Crackley Wood, Kenilworth, *Russell, Illustr.*
49. **Ag. acerbus,** *Bull.* Woods. Rare. Oct. Crackley Wood, *Russell, Illustr.*
52. **Ag. personatus,** *Fr.* *Ag. violaceus,* With. Woods. Rare. Pastures, Edgbaston, *With.*, 204. Bentley Park, *Bloxam.* Road sides, Brinklow Lane, *Adams.* Roadside, near Wolvey.
53. **Ag. nudus,** *Bull.* Woods. Rare. Oct. Edgbaston, *With.*, 201. Kenilworth, *Russell, List.* Combe; Hopsford, *Adams.* Sutton Park.
54. **Ag. cinerascens,** *Bull.* Woods. Rare. Aug. Dale House Lane, Kenilworth, *Russell, Illustr.*
55. **Ag. grammopodius,** *Bull.* *Ag. graveolens,* With. In pastures. May-Oct. Red Rock Plantation, Edgbaston; in rings under trees in the garden at Packington, *With.*, 178. In rings under trees in Ragley Park; at Pophills and other places in the neighbourhood, *Purt.* iii., 206. Sutton Coldfield.
56. **Ag. brevipes,** *Bull.* On bare soil. Rare. Sutton Park and Crystal Palace Grounds, Sutton.
57. **Ag. humilis,** *Fr.* Amongst grass. Aug.-Oct. Meadows, Kenilworth, *Russell.* Edgbaston, *Robinson!* Sutton.
58. **Ag. pædidus,** *Fr.* In fields. Sept.-Oct. Fields near Maxtoke Priory, abundant.

(To be continued.)

CONCHOLOGICAL NOTES FROM SOUTH BEDS.

The prevailing subsoil of South Beds being calcareous, it is not surprising that the shell bearing mollusca are numerically abundant in the district. It is also probably rich in specific forms, which is rather suggested than proved by the following list, which is almost entirely the result of two seasons' work by my son Edgar, who at present is quite a juvenile. The nomenclature may be accepted with confidence, as specimens of every variety have been forwarded to Mr. Taylor, of Leeds, to whom we are deeply indebted for his assistance in naming.

CLASS I. CONCHIFERA.

FAMILY SPHÆRIDÆ.

Sphærium corneum, River Lee, in Luton Hoo Park; Ponds at Limbury.
var. nucleus, Limbury.
lacustre, Limbury. Near Dunstable. R. Rogers.
Pisidium pusillum, Pond at Hitchin End, amongst *Hypnum aduncum.*

FAMILY UNIONIDÆ.

Anodonta cygnea, abundant in the River Lee, South of Luton.

CLASS II. GASTEROPODA.

ORDER I. PECTINIBRANCHIATA.

FAMILY PALUDINIDÆ.

Bithynia tentacula, Limbury.

ORDER II. PULMONOBRANCHIATA.

FAMILY LIMNÆIDÆ.

Planorbis albus, Pools at Limbury and Harlington.
vortex, Pools at Limbury.
curneus, Pools and Streams, Limbury, Biscot, and Luton Hoo Park.
contortus, Pools, Limbury.
complanatus, Pools, Limbury.
nitidus, ,, ,,
marginatus, ,, ,,
nautileus, Pools, Limbury; Hitchin End, with Pisidium pusillum.
Physa fontinalis, Luton Hoo Lake.
fluviatilis, sources of the River Lea, Leagrave.
Limnea peregra, Limbury, Biscot, Luton Hoo Lake. Near Dunstable. R. Rogers.
var. ampullacea, Luton Hoo Lake.
var. oblonga, Limbury.
auricularia, Luton Hoo Lake, very fine.
var. minor, with the type, Luton Hoo Lake.
stagnalis, common.
var. turgida, Limbury.
palustris, Limbury.
Ancylus lacustris, Reed Pond, Sundon, Limbury.

TERRESTRIAL.

FAMILY LIMACIDÆ.

Arion ater, Luton.
flavus, ,,
hortensis, Luton.
var. subfusca, Luton.
Bourguignati, General Cemetery, Luton.
Limax agrestis, Luton.
var. sylvatica, near Luton.
maximus,
var. fasciata, Luton.

FAMILY HELICIDÆ.

Succinea putris, Limbury Marsh, Flitwick Marsh.
Vitrina pellucida, Luton, Limbury.
Zonites cellarius, near Luton, Someries Castle.
nitidulus, Garden, Luton.
crystallinus, Limbury.
Helix aspersa, common.
nemoralis, common.

var. castanea,	00000	Luton.
var. libell.,	00000	
var. ,,	00300	
var. rubella,	00300	
var. carnea,	00300	

hortensis.

var. carnea,	00000	Luton.
var. lutea,	123 45	Dunstable Downs. R. Rogers.

arbustorum, Luton. Dunstable Downs. R. Rogers.
var. alpestris, Totternhoe Mead.
rufescens, Luton. Dunstable Downs. R. Rogers.
var. rubens, Luton.

Helix hispida, Limbury, Luton.
sericea, Limbury.
cantiana, Luton. Dunstable Downs. R. Rogers.
virgata, Warden Hills. Dunstable Downs. R. Rogers.
caperata, Warden Hills.
var. fulva, Chalk Pit, near Luton.
ericetorum, on the Chalk Hills. Dunstable Downs. R. Rogers.
rotundata, near Luton. In the General Cemetery quite a colony was found in an old boot.
pulchella, Harlington. Biscot.
lapicida, Limbury.
Bulimus obscurus, near Luton.
Pupa marginata, Warden Hills.
Vertigo pygmea, „
Clausilia rugosa, Limbury, Chorlton, Luton, &c. A dead shell, with two mouths, was found at Limbury.
laminata, Luton, Limbury.
Cochlicopa lubrica, Limbury.
Achatina acicula, Dunstable Downs.

FAMILY CARYCHIIDÆ.

Carychium minimum, Limbury, by the Catsbrook.

FAMILY CLYCLOSTOMATIDÆ.

Cyclostoma elegans, common on the Chalk Hills.

J SAUNDERS, LUTON.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

WEDNESDAY AND THURSDAY, JULY 4TH AND 5TH.

The following is the programme of proceedings for the forthcoming Meeting of the Union at Northampton:—

WEDNESDAY, JULY 4TH.

COUNCIL.—The Council will assemble at 11.30 a.m., in the Old Museum Room, at the Town Hall, Northampton.

ANNUAL MEETING will be held at 2.30 p.m., in the Old Museum Room, at the Town Hall; the President of the Union (The Right Hon. Earl Spencer) in the chair.

An address will be delivered by the Rev. H. H. Slater, F.Z.S., Vicar of Irchester, Northamptonshire, and member of the British Ornithological Union.

The further business of the Meeting will be to receive the report of the Council and the Treasurer's accounts, to fix the place of the next Annual Meeting, to consider any suggestions that members may offer, to discuss the work of the Union during the coming year, and to transact all necessary business.

Opportunities will be afforded for visiting some of the chief places of interest in the town, including some of the principal manufactories.

The Rev. T. C. Beasley, hon. sec. of the Northampton Architectural Society, has kindly consented to conduct a party to view the most interesting of the Churches of Northampton, leaving the Town Hall at 4 p.m., after the Annual Meeting.

Reception Room.—A Reception Room will be provided at the Peacock Hotel, Market Square, for the convenience of visitors, and letters may be addressed there. Visitors are requested to enter their names and temporary addresses in the arrival book, which will be on the table. The room will be supplied with newspapers.

Luncheon.—A Luncheon will be provided at the Peacock Hotel, at 1.30 p.m., for the Council, members of the Union, and visitors. Tickets, 2s. 6d. each; early application for which is requested.

The Conversazione will be held in the Town Hall, on Wednesday evening, at 7.30.

The Northamptonshire Natural History Society has arranged for exhibitions of objects of scientific interest by its various sections, and by the members of other Societies in the Union. There will be a number of microscopes and other scientific instruments. The Society will be much obliged for the loan of microscopes, instruments, or objects from the members of the Union.

In connection with the Geological Excursion on the following day (Thursday), B. Thompson, Esq., F.G.S., will read a short paper on "The Jurensis Zone in Northamptonshire."

The Conversazione has been arranged in connection with the Annual Meeting of the Northampton Architectural Society, and short papers will be read by members of that Society during the evening.

Arrangements have been made for selections of instrumental music to be given during the evening. Tickets, 2s. each. *Evening dress optional.*

Thursday, July 5th.

Excursions.

1.—Archæological Excursion.—Members of the Union and friends will be permitted to join the Annual Excursion of the Northampton Architectural Society, under the leadership of Sir Henry Dryden. The party will leave the Castle

Station at 9.20, and proceed by train to Higham Ferrers. Here they will be met by a coach, and drive to Higham Ferrers Church, Rushden, Irchester, and Castle Ashby, where they will lunch, and visit the Castle and grounds. They will then drive to Whiston and Earl's Barton, inspecting the fine Saxon Tower of the Church there, and reach Northampton about 6 p.m. Those who prefer can take the train at Castle Ashby at 3.39, reaching Northampton at 3.59. *Applications for this excursion must be made before June 25th.*

2.—Botanical Excursion.—The train will be taken to Daventry, whence the party will drive to Fawsley. By kind permission of Sir Rainald Knightley, there will be an opportunity of exploring Badby Woods, one of the best botanical localities in the county, and of visiting the Dower House, and other objects of interest in Fawsley Park. Lunch will be provided on returning to Daventry.

3.—Geological Excursion.—After visiting some of the more important pits in the neighbourhood of Northampton, the Limestone Works at Moulton Park will be inspected, and the party will proceed by Brampton to Harlestone, where they will lunch. It is hoped that Althorp House may then be visited, and on the return journey various sections of the Inferior and Great Oolites will be seen.

Tickets for either excursion will be 8s. 6d. (including luncheon).

Early application should be made for tickets, the possibility of carrying out the excursions depending greatly on the number of applicants.

All applications to be addressed to H. N. Dixon, Esq., Wickham House, East Park, Northampton.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 124.)

Edwin Lees, in Hist. Ill. Nat. Hist. Worc.

* **Dianthus Armeria**, 163. In a meadow beyond Mudwall Mill, and about Cotheridge. Also at Shrawley, near the church, and in a meadow near Kempsey. S.G. L.M.

* **Saponaria officinalis**, 163. By the side of the pool in Shrawley Wood. Also near Bewdley and Bromsgrove Lickey. S.G. L.M.

Silene noctiflora, 163. In a sandy field behind Birchen Grove, Broad Heath.

* **Mœnchia erecta**, 153. Rocks on the North Hill, Malvern.

* **Stellaria uliginosa**, 163. In various marshy spots about Hartlebury Common, Malvern Hills, Ashmore Common, &c. L.M.

Arenaria trinervis, 163. Shady lanes about Worcester. Ankerdine Hill.

* **A. tenuifolia**, 163. Lane near the Toot Hill, behind the Virgin's Tavern, Worcester. *A doubtful record. Not acknowledged in the Severn district in Mr. Lees's "Botany of Worcestershire."*

* **A. rubra**, 163. A pretty ornament of the dry declivities of the Malvern Hills. L.M.

* **Spergula nodosa**, 164. In the rill that rises in the declivity between the Worcestershire Beacon and the Sugar Loaf Hill, Malvern. *This is the plant called by Mr. Lees "Spergula saginoides" in Loudon's Magazine.* !

Scleranthus annuus, 163. On the rocks of the Malvern Hills.

* **Montia fontana**, 152. Plashy rills on the Malvern Hills, and on the Common called the Link. S.G. L.M.

* **Hypericum Androsæmum**, 173. In a hedge at the western base of the Worcestershire Beacon, Great Malvern. Mr. James Goodman. On Abberley Hill, growing among the underwood to a great size. Messrs. Walcot, Lees, and Edmunds. Also on Bredon Hill, above Elmley Castle. L.M.

H. calycinum, 173. In a copse at Little Malvern, but doubtful if truly wild. Mr. Lees.

H. quadrangulum, 173. Lane at Kempsey, and many marshy spots in the county.

* **H. humifusum**, 173. On the North Hill, Malvern. Dr. Streeten. Also near Nunnery Wood and on Helbury Hill.

* **H. hirsutum**, 173. Woody places about Worcester, not unfrequent.

* **H. montanum**, 173. Shrawley Wood and Abberley Hill.

* **Malva moschata**, 171. At Henwick Hill, Helbury Hill, and various other places, chiefly by the road side.

* **M. rotundifolia**, 171. Not frequent in this county. At the base of the North Hill, Malvern. About Kempsey.

* **Tilia parvifolia**, 166. Glens and lanes about the Old Storage Hill, and at Clifton-on-Teme. L.M.

‡* **Linum usitatissimum**, 159. In Cowleigh Park, to the north of Malvern. *Cowleigh Park is in Hereford.* L.M.

* **Geranium sylvaticum**, 170. In Bewdley Forest, near to Dowles Brook, plentifully. Messrs. Walcot and Lees.

* **G. pratense**, 170. Strikingly conspicuous with its large azure flowers, and a great ornament to the banks of the Severn and many of our minor brooks.

* **G. columbinum**, 170. By the side of the shady walk beyond the Old Waterworks, and in several lanes about Worcester and Hallow. On Abberley Hill.

* **G. lucidum**, 170. By the side of the moors, Worcester, and along the lane at Merryman's Hill. At Malvern, Abberley, &c. S.G. L.M.

Erodium cicutarium, 170. By the side of the road near Hallow, abundantly, and in the road leading to Mr. Farley's, Henwick Hill. Pasture at Kempsey.

* **E. maritimum**, 170. Growing in considerable plenty on the rocks fronting the south-west at the Giant's Grave, Habberley, 1834. Mr. Lees.

* **Euonymus europæus**, 156. In a hedge near the end of the avenue at Dr. Berkeley's, Cotheridge Court. Also near Malvern.

* **Rhamnus catharticus**, 156. In the hedges about Worcester, formerly common. In the coppice near Battenhall.

* **R. Frangula**, 156. In Wyre Forest.

* **Anthyllis vulneraria**, 171. Abundant on the limestone on the western flanks of the Malvern Range, and equally plentiful on the lias at Craycombe Hill. L.M.

†* **Trifolium ochroleucum**, 173. On the Link, at Malvern. *An error.*

* **T. arvense**, 173. At Malvern, Powick, and on Hartlebury Common.

* **T. fragiferum**, 173. On the Spetchley Road before the late enclosures. Evesham, on the Stratford Road. Avon Meadows, Pershore.

Lotus major, 173. In the Gullet, a woody glen of the Malvern Range, and at the base of Abberley Hill. Tiddesley Wood, near Pershore.

* **Astragalus glycyphyllus**, 172. Helbury Hill, Worcester; the Trench Woods, &c.

* **A. hypoglottis**, 172. Bredon Hill, near the Camp. Nash. Still there about two fields southwards of the outer vallum. Mr. Lees.

* **Ornithopus perpusillus**, 172. On the Malvern Hills, Hartlebury Common, Kempsey Common, and Blakebrook, near Kidderminster. L.M.

* **Hedysarum Onobrychis** (*Onobrychis sativa*), 172. Abundant on the Abberley Hills. Also on the limestone west of the Malvern Chain, and on the lias at Craycombe. L.M.

* **Vicia sylvatica**, 172. In the Devil's Den, Clifton-on-Teme, and in a wood near the Spout, Malvern. In the greatest luxuriance at Lower Sapey. Dr. Field, and Messrs. Allies and Lees, 1834. S.G. L.M.

* **V. angustifolia**, 172. Near the Giant's Grave, Habberley. Ankerdine Hill.

V. lathyroides, 172. Battenhall Lane, Craycombe Hill, and numerous other places in the county.

* **V. bithynica**, 172. Below the Ivyscar Rock, Great Malvern. Mr. Lees.

* **Lathyrus Aphaca**, 171. Near Crowle. Mr. Sheppard, 1834.

* **L. Nissolia**, 171. Among the bushes beyond Battenhall Lane, Worcester, and by the wood near the Croft Farm, Mathon. Mr. Lees. Also in a meadow at Kempsey. Dr. Streeten. S.G.

* **L. sylvestris**, 171. Perry Wood, and Helbury Hill, on the east side of Worcester; in the woods about Bredon Hill; and Tiddesley Wood, near Pershore. S.G.

* **Prunus insititia**, 164. Dudley Castle Hill. S.G.

*† **P. domestica**, 164. In the hedges near Battenhall, but doubtful if wild.

* **P. Cerasus**, 164. Wild cherry tree. (*Must be P. Avium, L.*) On Rosebury Rock, Knightwick, and Ankerdine Hill. A solitary tree appearing on Helbury Hill, near Worcester, when the wood was cut down. S.G.

* **Spiræa Filipendula**, 165. At the west end of Perry Wood, and on the Old Hills, but rather rare. Hedges at Brookend, near Kempsey. S.G.

* **Agrimonia Eupatoria**, 164. Frequent by road sides in various places.

* **Sanguisorba officinalis**, 153. Very rare. In moist ground at the south-west side of Nunnery Wood. S.G. *Not uncommon in the north of the county. "Fairly common between Madresfield and the Rhydd." Mr. Towndrow.*

Alchemilla arvensis, 153. Lanes about Henwick, and Malvern Hills.

* **A. vulgaris**, 153. Lane leading to Henwick Mill. Also in fields at Grimley and Alfrick. L.M.

‡ **Tormentilla reptans**, 166. Near Cowleigh Park, north of Malvern. *Probably a Hereford record.*

* **Potentilla argentea**, 166. On the sand rock between Bromsgrove and Droitwich. On a similar rock near Holt, &c. L.M.

‡* **P. verna**, 166. On the rocks of the Herefordshire Beacon, Malvern. Mr. Lees. L.M. *A Hereford record.*

* **Comarum palustre**, 166. On Hartlebury Common, and in pools about Bromsgrove Lickey.

(*To be continued.*)

REMARKS AS FOOTNOTES TO "THE CLIMATE OF BRISBANE."

The highest percentage of relative humidity, viz., 100, or absolute saturation, usually occurs in the early morning before sunrise, and the lowest percentage in the afternoon.

The most striking meteorological event during the year was the heavy rainfall of January 21st, 18·305 inches, or 1,848½ tons per acre falling within 24 hours. This fall occurred during the passage of cyclonic disturbance from the neighbourhood of New Caledonia; and the disastrous floods resulting in the south-eastern portion of the colony form a prominent feature in the history of Queensland.

Much valuable information relating to the distribution of pressure over Eastern Australia may be gathered from the

NOTES ON THE CLIMATE OF SOUTH QUEENSLAND.

THE CLIMATE OF BRISBANE* DURING THE YEAR 1887.

BY CLEMENT L. WRAGGE, F.R.G.S., F.R. MET. SOC., ETC.,

GOVERNMENT METEOROLOGIST FOR QUEENSLAND (LATE OF BEN NEVIS OBSERVATORY).

Month.	PRESSURE.			SHADE TEMPERATURE.							HYGROMETRIC CONDITIONS.					WIND.		CLOUD.	RAINFALL.	
	Mean pressure. Barometer at 32° Far.	Highest reading of barometer. †	Lowest reading of barometer. †	Mean temperature of air.	Mean temperature of evaporation.	Max. shade temperature of air.	Min. shade temperature of air.	Mean daily range.	Mean max.	Mean min.	Mean vapour tension.	Mean humidity. (Saturation equals 100.)	Mean dew point.	Highest humidity.	Lowest humidity.	Velocity in miles per hour.	Prevailing.	Amount. (Scale 0 to 10.)	No. of rainy days.	Total for month.
January	29·854	30·040	29·560	76·6	70·8	92·5	64·2	15·0	85·1	70·1	·656	72	66·7	100	30	12	E.	5·8	17	23·334
February	29·874	30·184	29·321	74·2	69·6	92·6	62·3	13·3	81·7	68·4	·645	76	66·3	100	47	11	S.E.	7·2	25	6·403
March	30·000	30·264	29·783	74·3	70·7	88·4	63·5	12·6	81·7	69·1	·689	81	68·1	100	46	11	S.E.	7·0	30	12·088
April	30·107	30·277	29·910	67·2	64·6	84·1	55·1	14·5	77·3	62·8	·568	85	62·5	100	50	11	S.	5·0	28	3·341
May	30·098	30·282	29·825	61·0	55·9	79·4	44·5	18·0	70·9	52·9	·381	72	51·5	100	35	9	S.	4·3	13	3·046
June	30·010	30·429	29·738	56·3	50·1	75·0	41·9	17·3	65·7	48·4	·293	65	44·4	100	38	9½	W.	3·7	5	0·168
July	30·118	30·391	29·807	57·5	52·4	77·0	40·4	18·9	67·7	48·8	·332	70	47·8	100	35	7½	W.	4·1	8	7·507
August	30·198	30·445	29·925	59·3	55·0	76·5	37·4	18·4	69·5	51·1	·377	74	51·2	100	32	7½	S.	5·2	19	11·796
September	30·034	30·248	29·657	63·2	56·4	80·7	44·5	19·9	73·6	53·7	·369	64	50·7	100	25	10	W.	3·5	17	1·921
October	30·038	30·356	29·684	68·5	61·5	90·6	50·6	21·3	79·9	58·6	·450	64	56·0	100	12	12½	N.	4·1	22	4·824
November	30·030	30·267	29·662	69·7	63·3	90·7	54·9	18·8	79·9	61·1	·488	68	58·3	100	10	14	N.	5·8	29	2·970
December	30·072	30·264	29·721	72·3	65·8	88·0	59·5	16·0	80·9	64·9	·536	68	60·9	100	27	14	E.	6·2	25	4·138
Grand means for year, with total rainfall	30·036			66·7	61·3			17·0	76·2	59·2	·466	71	56·9			10¾		5·2		81·536 Total rainfall for year.

* As the reorganisation of the Queensland Meteorological Observing-System could not be *commenced* until January 1st, 1887, it is obvious that complete climatological records for the year 1887 for other stations than Brisbane cannot be given.

† Corrected and reduced from self-recording instruments.

prevailing winds at Brisbane alone. For instance, the easterly currents of December and January prove that seasonal low pressure exists over North Queensland, and that prevailing anticyclonic or high-pressure systems cover New South Wales, and overlap its coast-line.

The south-east currents of February and March show that anticyclonic nuclei, or "mounds" of high pressure, are then of frequent occurrence over the Riverina country, and that their north-eastern slopes over-reach the Queensland border and the Pacific coast.

The southerly winds of April and May distinctly show the progress of the earth's revolution and its effect on the pressures. The sun's northern declination is increasing, hence the land of Australia is chilling and the air becoming denser. This tends to draw the high-pressure centres nearer the Tropic of Capricorn.

The westerly winds of June, July, and September are intensely dry and chilling, but distinctly purifying and bracing. They prove that the anticyclone or high-pressure system, which is a seasonal feature of the interior at this time, has its nucleus near Alice Springs, and that its slopes extend well over Northern Queensland, while low pressure or cyclonic systems cover the ocean between New South Wales and New Zealand.

The southerly currents of August indicate a temporary "backing" to southward of the anticyclone of Central Australia, and a low barometer at Norfolk Island.

The northerly winds of October and November indicate in a most striking manner the effect of the sun's increasing southern declination. The atmosphere over the continent is becoming heated and more rarefied. The central high pressures have collapsed, and areas of low barometer are taking their place, while anticyclonic types are forming on the ocean side of the Barrier Reef.

In accordance with the rules of the Royal Meteorological Society, values of 0·006 and over are taken as rainy days. During September, October, November, and December, however, heavy dews frequently gave 0·006. Virtually the actual number of rainy days for those months was as follows:—viz., 8, 11, 20, and about 15 respectively.

From an intelligent perusal of the figures in the synopsis of the Brisbane weather, it is evident that the South-east portion of Queensland possesses a decidedly genial climate. Although December, January, and February are virtually tropical months, a new arrival from the Old Country may enjoy the best of health by partaking freely of those luscious

fruits, such as bananas, pineapples, and melons, which are produced in lavish abundance; by abstaining from the use of animal food in such quantities as was his wont in northern climes, and by abjuring all excess in alcoholic stimulants. The climate during the remainder of the year is delightful, although the westerly winds of winter may be rather too bracing for those who have long suffered from serious chest affections. And, again, our observations so far show that the climate of those vast inland regions, such as the Darling Downs, Maranoa, and Warrego districts, is distinctly salubrious and much drier than that of the ocean slope. In fact, during those months that are virtually tropical on the Pacific coast, where the humidity is relatively high, the difference between the dry and wet bulb thermometers at such places as Roma and Thargomindah may exceed 37 degrees, giving a percentage of humidity as low as 4, saturation equalling 100. Heavy ground frosts occur on the Downs and Border Tableland during May, June, and July, and ice is of frequent occurrence there during that period.

That there is a variety of climate within South Queensland suitable for every type of those invalids, to whose restoration to health climatological conditions are the most important factor, is my firm conviction; and when we consider the abundant rainfall of Eastern South Queensland (despite periods of drought) as compared with that of some places in the Southern Australian Colonies, and the magnificent agricultural, pastoral, and mineral resources of the Southern portion of the colony as a whole, it is evident that Brisbane, as the capital city and principal outlet of produce, must increase, and that it has before it a future that will prove unique in the annals of prosperity, and in the history of the great British Empire. I believe that the underground water reservoirs in the far West are most ample. I reserve notes on the climate of North Queensland until more data are forthcoming, although from what is already known of its tropical climate and magnificent natural wealth, it is difficult to foresee a future any less brilliant than that we most conscientiously predict for the Southern portion of the colony.—Clement L. Wragge, *Government Meteorologist of Queensland.*

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical Section.—May 3rd. The first meeting of the section this year was made special by a large number of microscopes being exhibited, and the members were successful in affording

a very interesting and instructive evening. After a few introductory remarks from the president, Mr. W. B. Grove, B.A., Mr. W. P. Marshall read a paper from Mr. E. W. Burgess, giving an account of the Foraminifera dredged by this Society during the Oban Excursion, in 1883, and a fine slide of sixty-seven named and mounted specimens, prepared by him from that material, was presented to the Society. Amongst the objects exhibited were the following:—Mr. W. B. Grove, B.A., *Bovista nigrescens* and *Badhamia hyalina*, from neighbourhood of Shustoke; *Peronospora alsinearum*, Casp. (new to Britain), from Fillongley; *Peziza leucomelas*, Pers. (new to Britain), from Clevedon; also, for Mr. Walliker, a piece of the so-called Lydian stone, used as a touchstone to distinguish pure from base metal; and a portion of a stone ornament, blown up and thrown into the instrument room at the Telegraph Office, Cannon Street, during the fire at Messrs. Marris and Norton's. Mr. T. H. Waller, B.Sc., granules and crystals of zircon and rutile, from Oldbury. Mr. W. P. Marshall, M.I.C.E., tadpole of frog, showing the circulation in the external gills, &c. Mr. J. Edmonds, *Trypeta reticulata*. Mr. F. Derry, crystals of brucine. Mr. J. Udall, circulation in gills and tail of tadpole. Mr. T. E. Bolton, *Œdogonium*, showing fructification; *Closterium rostratum*, with zygospores; and *Lophopus crystallinus*. Mr. W. H. Wilkinson, specimens of lichens from Mount Stewart, Isle of Bute, gathered during the visit of the Cryptogamic Society of Scotland; a collection of lichens from near Crieff; and from Dr. J. Stirton, the following rare and interesting lichens, *Cladonia lacunosa*, from Newfoundland; *C. retipora* and *C. aggregata*, from New Zealand; *C. cariosa*, from Norway; and *Myriangium Duriaci*, from Cornwall.—On Whit Monday, a party of about fifty members of this Society made an excursion to Dovedale. On reaching Derby they drove *via* Ashbourne to the foot of Thorpe Cloud, and after luncheon the party proceeded to the Dale, under the guidance of the Rector of Alstonefield. Some of the more uncommon plants seen were *Saxifraga granulata*, which was abundant everywhere; *S. hypnoides*, on the slopes of Thorpe Cloud; *Arabis hirsuta*, on rocks in the stream; while *Myosotis collina*, *Veronica arvensis*, *Saxifraga tridactylites*, geranium, and the pretty little draba formed a many-coloured patch on every boss of rock where the soil was thinnest. The rare moss *Neckera crispa* was also gathered, and the place was pointed out where *Hypnum rugosum*, the "Dovedale moss," was formerly so abundant, though now scarcely a fragment can be found. This latter species never fruits in England now, and it was suggested that this may be the cause why it was unable to maintain its ground. On the return journey, Derby was reached at 8.45. A short visit was here paid by some of the party to the Free Library, to seek for a memorial of Mr. Herbert Spencer, who was born in a little house, No. 8, Wilmot Street, Derby. Sociological Section.—April 24th. Mr. W. R. Hughes, F.L.S., in the chair. A vote, congratulating Mr. Herbert Spencer on attaining his sixty-eighth birthday, was passed; and the secretary was requested to forward the same to him. A vote of condolence with the family of the late Mr. Matthew Arnold was also passed. A paper was read by the hon. secretary, Mr. F. J. Cullis, upon Prof. Fiske's "Cosmic Philosophy." Supplementary Meeting, held Thursday, May 3rd. Mr. W. R. Hughes, F.L.S., in the chair. A letter from Mr. Herbert Spencer was read, replying to the vote of congratulation passed at the previous meeting. An exposition was given by Mr. Stone on the fifth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Reconciliation." An animated discussion followed. Supplementary Meeting, held May 17th. Mr. W. R. Hughes, F.L.S., in the chair.

Mrs. A. Browett gave an exposition of the first chapter of the second part of Mr. Herbert Spencer's "First Principles," entitled "Philosophy Defined." A discussion followed.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 23rd. The Chairman presented to Mr. C. Beale, C.E., on the occasion of his leaving England, a handsomely bound copy of Longfellow's Poems, with an illuminated address on the title page, as a testimonial of the esteem in which he was held, and in recognition of his many kindnesses to the Society. Mr. Beale having suitably replied, the following exhibits were made:—Mr. Evans, *Trigonia gibbosa* in Portland stone, also specimen of rhyolite from the Wrekin; Mr. W. H. Bath, collections of marine algæ from Weymouth and Bournemouth. Under the microscope, Mr. Collins showed a section of stem of dog rose through a spine; Mr. Hawkes, tetraspores of *Callothamium roseum* and *Dasya coccinea*.—April 30th. Mr. W. H. Bath presented a copy of his book, "The Young Collector's Handbook of British Birds: their Nests and Eggs." Mr. J. Madison exhibited specimens of *Helix pisana*, from Guernsey; Mr. J. Betteridge, specimen of dunlin, *Tringa alpina*, in full summer plumage, shot near Westheath; also a specimen of common tern, *Sterna fluviatilis*, from Harborne. Mr. J. A. Green then read a paper on "The Polarization of Light." The writer said the term polarization was a description of any cause which produced two opposite or antagonistic states. It would be necessary to take into consideration the normal condition of light before we could understand the changes that took place. Light was compound in its nature, and was seen analysed in the solar spectrum. The structure of the Nicol's prism was described, and how it divided the two rays, reflecting one and refracting the other, and the arrangements for adapting them to the microscope were shown. The paper concluded by referring to the use of polarized light in the study of mineralogy, chemistry, and other sciences.—May 7th. Mr. Deakin exhibited specimens of butterflies, from British Burmah; Mr. J. Madison, specimens of *Helix cartusiana*, *Clausilia itala*, *Pupa frumentum*, and other shells, from Italy; Mr. Barradale, cotton pods, from Ceylon and China; Mr. J. W. Neville, a series of objects illustrating the development of *Nepa cinerea* from the egg to the imago.—May 14th. A lecture was delivered by Mr. T. H. Waller, B.A., B.Sc., on the "Micro-Chemical Examination of Minerals." The speaker said that when you examined a thin section of rock, owing to the crystals being seen in section, there was some difficulty in making out its constituent parts, although a judicious use of the polariscope would distinguish grains of quartz from hornblende. It therefore became necessary to adopt some more certain method. The pulverization and sifting of minerals was unsatisfactory, and their chemical analysis was very difficult. The lecturer said very good and certain results could be obtained by means of flame reactions with a Bunsen's burner. A number of experiments were made showing the effects of soda, potash, and lime felspars on the flame, and the effects produced enabled the observer even to approximate to the proportion of the alkalies. In addition to this mode, solutions must be made by dissolving the minerals and crystallizing them under the microscope, when the results would throw further light on the subject. The lecturer concluded by saying that in the way he had pointed out a large amount of knowledge might be gained from a small piece of material, and very valuable aid obtained in the examination of rocks. At the close of the lecture, several solutions were shown crystallizing under the microscopes.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.*

BY J. G. BAKER, F.R.S., F.L.S.

When our friends come to visit us at Kew it is usually in May, June, or July, when the days are long and the Garden is in its full perfection. But as this is the busiest time of the year I am afraid that the questions they ask are liable to get answered very briefly and incompletely, and if it be a matter where figures are involved it is both difficult to remember them on the spur of the moment, and difficult for the memory, even when they are told correctly, not to mix them up together. I propose, therefore, to occupy my allotted hour this evening in attempting, in the comparative leisure of mid-winter, to answer more fully and precisely than is possible in conversation a few of the principal questions about Kew which are asked most frequently by those who wish to form a full and intelligent idea of the plan and purposes of the establishment.

The General Plan of the Kew Establishment.

The aim of a National Botanic Garden is to illustrate as fully as possible the plants and their products, in the first place of the country to which it belongs, and subserviently to this the plants of other parts of the world. First of all we must possess the means of distinguishing from one another and identifying the separate individual kinds of plant, and based upon this follows the investigation of the different points of interest connected with their life-history and various economic uses, as food or clothing, or in medicine and the arts. It is quite safe to say that none but a very limited number of specialists have any idea of the enormous number of different kinds of plants there are in the world. A very moderate estimate, founded on the figures as they stand in Bentham and Hooker's "Genera Plantarum" for the flowering plants alone, leaving out of account the ferns, and all the lower orders of Cryptogamia, is 200 natural orders, 10,000 genera, and 100,000 species. Although the possessions of Britain occupy only about one-sixth part of the world, yet they lie so far apart from one another, and under so many different conditions of latitude and longitude and climate, that they

* A Lecture delivered at the Friends' Meeting-house at Westminster, January 26th, 1886, and at the Birmingham Natural History and Microscopical Society, May 29th, 1888.

produce nearly one-half of the whole total number of the plants that are known. For Europe, in an area of under 4,000,000 square miles, there are about 10,000 species of plants known; take 1,500 species as an estimate for the British Isles, and add as many more for Gibraltar, Malta, and Cyprus, and this gives us 3,000 species. For India, where we have every range of climate from equatorial heat to perpetual snow, an estimate of 15,000 species is not excessive. For Cape Colony, and our tropical possessions in Africa, including Mauritius, and the Seychelles, say 2,000 species. For Australia, New Zealand, and Fiji, another 10,000 may safely be added. For the British possessions in North America we may safely say 8.000 species, nearly all of which are amongst the 10,000 which make up the flora of the United States. For the British West Indies and Guiana, 5,000 will not be over the mark, or, to take the British possessions by continents:—

Europe	3,000	species.
Asia	15,000	,,
Africa	10,000	,,
Australia and Polynesia ...	10,000	,,
America	8,000	,,

These numbers add up to 46,000, and in this estimate there will not be a large number of plants counted twice over. Amongst the many excellent things planned by Sir William Hooker was a series of floras, classifying and defining the plants of all the British possessions upon one uniform system. Of these the volumes for Australia, New Zealand, Hong Kong, the West Indies, and Mauritius, are finished; that for India, the most extensive of all, for which Sir J. D. Hooker himself undertook the onerous task of editorship, is far advanced; those for the Cape and tropical Africa are about half finished, whilst the plants of Fiji and the British possessions are fully dealt with in another form, and those of Guiana have been to a considerable extent included in the great flora of Brazil, which has been brought out at the expense of the Brazilian Government.

The objects, as I have already indicated them, of a national botanic garden are at Kew, as at all other fully-equipped establishments of the same kind, carried out by three different departments, as follows: 1st. The Garden, in which a selection of the most interesting plants are cultivated; 2nd. The Herbarium and Library, in which dried specimens of as many different kinds of plants as possible are gathered together, named, and arranged for ready reference, in company with a collection of botanical books and drawings; 3rd. The

Museums, in which the economic uses of the different kinds of plants are illustrated.

During the last ten years these three main essential departments have been supplemented through private liberality with an art gallery and physiological laboratory. I will, in the first place, say a few words about the details of each of these three departments.

The Garden

covers an area of 325 acres, and the grounds of the Queen's Cottage, to which the public are not admitted, are 26 acres more. Whilst a portion of the property was in the hands of Sir Henry (afterwards Lord) Capel, in the reign of Charles the Second, the Garden was already one of the best in the country. Kew House and the surrounding grounds were rented on a long lease by Frederic, Prince of Wales, in 1730, and they were purchased by his son, George the Third, a short time after he came to the throne in 1760. Prince Frederic died in 1751, and his widow, the Princess Augusta, who was a daughter of the Duke of Saxe Gotha, still continued to reside at Kew, and may be looked upon as the real originator of the botanic garden. Her principal adviser, the Earl of Bute, who was Prime Minister for a year in the early part of the reign of George the Third, was an enthusiastic botanist; he spent ten thousand pounds in printing an elaborate botanic work in nine volumes, of which only twelve copies were struck off.

During this middle generation of the eighteenth century the writings of Linnæus gave an enormous impulse to the popularity of botany. The first edition of his "Species Plantarum," in which the binominal Latin names of plants were first given to them, was first issued in 1753. For garden plants they were first popularised in England in the eighth edition of the "Gardener's Dictionary" of Philip Miller, of Chelsea, published in 1768. In the same year a catalogue of the plants then cultivated in Kew Gardens was published by Sir John Hill. It includes fifty ferns, between 500 and 600 trees and shrubs, and several thousand herbaceous plants. For a long time during the reign of George the Third and his successors, the Garden was managed by the two Aitons, father and son. The elder Aiton was born in 1731, came to England in 1754, entered the service of the Princess Dowager of Wales at Kew, in 1759, and died in 1793. With the aid of Dr. Solander he published, in 1789, a book called "Hortus Kewensis," containing descriptive characters of all the plants, 5,600 in number, then cultivated in the Garden.

In 1810, a second edition was published by his son, for the botany of which he was indebted to Dryander and Robert Brown. This contains descriptions of between nine and ten thousand species.

During the reigns of George IV. and William IV. the Garden was very much neglected. In 1840 it was first opened to the public, and was placed under the superintendence of Sir William Hooker. At that time the Garden only occupied an area of eleven acres. Within a few years it was extended by successive additions till it reached the seventy-five acres, which are still enclosed within a wire fence. In 1847 the 250 acres of what was called the Pleasure Ground were added, and were planted as an arboretum, or classified collection of trees. During the twenty-five years of the directorship of Sir William Hooker, the Museum and Herbarium departments were started and organised upon their present footing, and the Palm House, the large Temperate House, and the large Museum, were built, the former at a cost of £30,000. Sir William Hooker died in 1866, and was succeeded by his son, Sir J. D. Hooker, who for several years had filled the post of assistant-director. A very short time ago, after forty-eight years of public service in one form or other, Sir J. D. Hooker resigned the official directorship, and has been succeeded by Mr. W. Thiselton Dyer. The principal additions that have been made during the twenty years of Sir Joseph Hooker's directorship have been the new Herbarium, the Picture Gallery, the Laboratory, the long T shaped house, with varying temperatures, in the centre of the Garden, the Rockery, and the enlargement of the two Museums.

The only old buildings which still remain from the days of George III. are the Pagoda, which was built by Sir William Chambers about 1760, the King's Orangery (now used as a museum for large wood specimens), and various temples and ruins of the style in which our grandfathers delighted. The Tree-fern House near the great gates was sent from Buckingham Palace in the reign of William IV.

The annual number of visitors, which was under 10,000 in 1841, has now risen to over 1,000,000. On the summer Bank Holidays the number has lately varied from 50,000 to 95,000. Exclusive of Bank Holidays, the number of those who visit the Gardens on a Sunday is about as great as on all the other days of the week put together.

Since the institution was re-organised under Sir William Hooker, it has always been kept in view as one of its chief objects that it should be made as useful as possible to the Colonies, and from year to year a large proportion of the time

and thought of the director and assistant-director has been absorbed by their colonial correspondence, and in questioning and answering the questions of their colonial visitors.

STATISTICS OF PLANTS AS CLASSIFIED ACCORDING TO THEIR CULTURAL REQUIREMENTS.

If we classify plants according to the garden treatment they require, they fall into four main groups: the inter-tropical zone includes a land area of 40,000,000 square miles, and the total number of characteristically tropical plants known to science may be roughly estimated at 40,000 or 50,000. These are provided for at Kew in the Palm House, the Tropical Fern House, the Aroid House near the main gates, the central portion of the new range, and various small propagating houses, which are not open to the public. Of course the expense incurred in cultivating in the English climate any plant of this group is considerable, so that a careful selection from the 40,000 or 50,000 species has to be made.

The second group of plants consists of those that can bear the English summer, but need protection during winter. These are provided for at Kew in the Temperate House, the Succulent House, the cool Fern House, and the cooler parts of the new range. To this group belong the members of the three rich floras of the south temperate zone, where the height of summer corresponds with the depth of our north temperate winter. To this group belong about 30,000 species, or about a third of the plants that are known.

Next come the hardy plants. The north temperate zone occupies about one-third of the earth's surface, and its plants number 20,000 species. Of these at Kew the classified collection of the herbaceous types is contained in what is called the Herbaceous Ground, which is just north of the Cumberland Gate. Here are grown about 2,000 perennials and a thousand annuals, arranged under their respective orders.

The classified collection of shrubs and trees is scattered over the different parts of what was formerly called the Pleasure Ground. For the special growth of Alpine plants two rockeries have lately been laid out. The total flora of the Arctic zone does not reach 1,000 species, and the plants which are confined to the higher levels of the mountains of the north temperate may perhaps be twice as numerous, in all 3,000 species of what gardeners call "Alpines," plants specially adapted to a cold damp climate with a short summer. If we attempt to classify the plants of the British possessions under these four climatic groups, the result will be something like this:—

Tropical plants ...	18,000	species.
Half-hardy ...	18,000	,,
Hardy	8,000	,,
Alpines	2,000	,,
	46,000	species.

Drawbacks of a Botanic Garden.

It should be borne in mind that a Botanic Garden, from the nature of the case, differs in many respects from an ordinary garden. Many plants, which it is not worth while for a gardening firm to keep in stock are interesting from their structure or associations. The way to make a fine-looking collection of orchids, or ferns, or palms, is to select a few of the finest kinds, and grow several plants of each, eliminating from the collection altogether the less showy and ornamental kinds. It adds very much to the labour and thought required from the cultivator if a botanical arrangement is followed. For instance, take a genus like Ranunculus: some of the species grow naturally in swamps, some in pastures, some in woods, and some in waste ground. If these are grown side by side, the cultivator needs to individualise each species in order to treat it properly. A class of plants which are specially interesting to botanists are those which, either from their size or texture, cannot be properly represented by herbarium species, such as palms, cycads, tree ferns, and succulent plants.

(To be continued.)

ON THE SUCCESSFUL USE OF OIL TO CALM ROUGH SEAS.*

BY W. P. MARSHALL, M.I.C.E.

[Note.—The particulars given in this paper have been mainly collected from various published notices.]

The idea of making use of oil to calm and smooth the surface of water is an old one, as illustrated by the well-known old saying about throwing oil on the troubled waters; but it has been only in recent years that the subject has received any serious attention, and it was previously treated as merely fanciful and imaginary. The fact has, however,

* Transactions of the Birmingham Natural History and Microscopical Society, February 14th, 1888.

now become definitely established that there is a great deal of practical value in the idea, and that it admits of being put into use with very important advantage, and of even being instrumental in the saving of life, and the saving of vessels when exposed to rough seas.

Illustrations of this are given by the following cases:— A sailing vessel, the Stockholm City, crossing the Atlantic from Boston, encountered a terrible westerly gale, and had no alternative but to drive before it, a course that became extremely hazardous. The captain, therefore, resolved to make use of oil; and a bag of strong sail-cloth filled with tow, well soaked in oil, was suspended at each angle of the stern of the vessel, and allowed to trail in the water; two other bags were placed amidships, and two others at the bows. The action upon the waves is reported as instantaneous; the most dangerous breakers were converted into a harmless swell, and, whilst driving for about 170 miles before the storm, not a sea was shipped.

Another case is that of a sailing vessel, the Nehemiah Gibson; the captain, foreseeing a hurricane whilst sailing with the wind astern, and with a heavy sea which became constantly more violent, took two sail-cloth bags, each holding half-a-gallon of porpoise oil, and pierced with holes to allow the oil to leak out gradually. The bags were suspended so as to dip in the water, and the oil produced the desired effect. The huge waves that rushed into the ship's wake, with their breaking and dangerous crests, and rising much higher than the vessel, threatening to overwhelm her, were suddenly pacified as they reached the track of smooth water produced by the oil; the crests of the waves disappeared, and they passed harmlessly under the keel of the vessel.

The value of this method appears most signally where it becomes necessary to rescue the crew of a vessel in distress. The Martha Cobb, sailing from Newfoundland to Europe, rescued by this means the crew of a vessel about to founder. Her own cargo was petroleum, and as some of the casks leaked considerably the sea could be smoothed by simply working the bilge pumps. Bringing his ship as near as possible to the wreck, the captain was able to carry off the crew in safety in a very small boat, which would otherwise have been instantly swamped. He considers that, in any tempest or heavy sea, persons may be safely conveyed in boats from one vessel to another, provided the one to the windward makes a judicious use of oil.

For some years past the life-boats on the Australian coasts have succeeded in crossing the reefs in bad weather by

means of diffusing oil upon the water; and they do this without incurring any danger, and without shipping a drop of water. The oil forms amidst the breakers a smooth track, at each side of which the waves roll over with violence. Crews have been saved out at sea during storms by very small vessels without any danger; the two ships, lying-to as close to each other as possible, and oil diffused by the one to windward, formed between them a broad smooth track, affording perfect security for the boats. Several vessels loaded with the crews of other ships which had foundered, or had been destroyed by fire, owe their safety entirely to the use of oil, of which there was fortunately a supply on board at the time.

The Hydrographic Office, at Washington, has made a collection of duly authenticated cases of the use of oil; and Vice-Admiral Cloué, of the French navy, has given in a report upon the subject to the Paris Academy of Sciences, from both of which the above-named cases have been taken. As many as eighty-one such cases of ships safely driving before the wind have been reported, and seventy-two successful cases are also on record where vessels have encountered a head wind safely by the use of oil.

The best oils for the purpose are those of the seal and the porpoise; mineral oils have been used with success, but they are too light; and certain vegetable oils, such as that of the cocoa nut, congeal too quickly in cold seas. The hourly consumption of oil for this purpose need not exceed half-a-gallon. The arrangement for the diffusion of the oil, as commonly adopted on board ship, consists of a bag of strong sail-cloth, large enough to hold about two gallons, and filled with tow well soaked in oil. More oil is poured upon the tow, and the bag is sewn up, and its bottom is then pierced with several holes made with a sail-maker's needle. When sailing before the wind, one such bag is suspended at each angle of the stern, and allowed to trail in the water, and another bag is fixed a little forward on each side.

The effects of this simple process are surprising. All the numerous reports that have been collected agree that the oil diffuses itself over the water with extreme rapidity, and that, even when the waves previously seemed ready to swallow the ship, there at once appears a broad track of smooth water, within which all breakers are suppressed.

There is a natural phenomenon, not unknown to seafaring men, that might have sufficed to draw attention to the calming effects of oil half a century ago. Along the Malabar coast there is a certain track where the water is always remarkably tranquil, even during strong south-westerly

monsoons. The sea shows a kind of oily scum, which, as has been ascertained, is derived from springs of petroleum at the bottom, and which prevents the formation of breakers.

The sponge-fishers of Florida make considerable use of oil for the purpose of calming the surface of the water. During the greater part of the year the effect of the slight ripple on the water is easily overcome by a water-telescope, by the aid of which the fishers easily discern the sponges, and hook them up from the bottom. But it sometimes happens in the spring, that the roughness of the sea prevents the handling of both hooks and telescopes. Then the sponge-fisher throws a spoonful of oil upon the waves, which produces a calm about his boat as long as he cares to drift about with it. The oil preferred by the sponge-fishers for this purpose is obtained from the liver of the "nurse" shark; and so effective is this oil considered, that as much as four shillings a gallon is paid for it.

In the use of oil from a ship for calming the surface of the water, there is a difficulty in getting the oil well to windward unless the ship is either at anchor, or lying-to, or running before a gale. There have been two appliances brought out for effecting the distribution of the oil in any direction, without regard to the wind. The first one is specially intended to spread the oil between two ships which wish to communicate with one another in bad weather. The apparatus consists of a mortar and a few shells filled with oil, which are fired to various points on the water between the two vessels, and burst, thus allowing the oil to spread. Should the distance between the two ships be so great that it cannot be covered with oil, the oil from each of the shells would, nevertheless be of considerable use, forming little havens, into which the boat could go, and not only allow the men to rest and recover their strength for further battle with the wind and waves, but also furnish them with a place of comparative security during any exceptionally heavy bursts of the tempest. Under certain circumstances, this apparatus may be used for ensuring the safety of the vessel itself; for instance, when about to pass through a dangerous and narrow channel in bad weather with wind against tide, a few oil-charged shells may be fired ahead of the vessel with considerable advantage.

The second appliance is specially intended to distribute oil on the sea between a stranded vessel and the shore, in those cases when the vessel has no oil on board, and communication by boat is, with the assistance of the oil, practicable. It consists of a mortar and some hundred yards of fine light hose, to one end of which (the end being left open)

is attached a heavy iron weight, so shaped that it can be fired from the mortar. The apparatus is worked as follows:—On a ship going aground near the shore, the weight is fired from the shore as near to the ship as possible; the weight sinks, and acts as an anchor for the hose, through which oil is pumped from the shore. The oil rises near the ship, and being blown towards the shore (in most cases vessels are wrecked on a lee shore) forms a track of fairly smooth water for the boats to traverse. In cases when the whole volume of water rushes along and breaks, the oil has little or no effect, and, consequently, this apparatus would then be useless; but in ordinary broken water, the appliance will, no doubt, be of considerable service.

(To be continued.)

PASSAGES FROM POPULAR LECTURES.

BY F. T. MOTT, F.R.G.S.

VI.—THE UMBELLIFERÆ.

FROM A LECTURE DELIVERED IN 1876.

The ancient Greeks and Romans reckoned among their deadliest weapons the juices of three poisonous plants—aconite, hemlock, and poppy. Of these three the one whose name has come down to us with most historical prestige is hemlock. The world will never cease to remember with shame and grief the death of Socrates, nor that it was by a cup of hemlock juice that that noble life was lost.

This famous hemlock may be taken as a type of an umbelliferous plant, that natural order which is popularly marked by its flowers being produced in umbels. There are plants not of this order which also bear their flowers in umbels, as the ivy, the onion, and the polyanthus. These are not numerous, however, and their umbels are nearly always simple. The true umbellate inflorescence, especially the compound form, is in general a good distinctive character of the order.

Of these umbelliferous plants there are 1,500 species known to exist, which are classified into 150 genera,* showing an average of ten species to a genus, a very usual average

* 1,300 species, 152 genera, according to Bentham and Hooker, Genera Plantarum.—[Ed.]

among flowering plants. About sixty species are recognised as natives of Britain, and there are few counties in which half of this number might not be collected.

The region of the earth in which the Umbelliferæ are most common is the northern half of the north temperate zone in the eastern hemisphere. That is to say, the northern parts of Europe and Asia from the Arctic circle to the great mountain chains of the South, the Pyrenees, Alps, Balkans, Caucasus, and Altai. Beyond this district a few species are found as far as South Africa, America, and Australia, but they are only stragglers; the home and centre of the order is Europe and Asia northward of the southern chains. It is the region of cornfields ard orchards. South of this region is the home of the Labiates, and north of it the land of Saxifrages. The corresponding region in North America is marked not by Umbelliferæ, which are scarce there, but by some forms of the composites, especially asters and golden-rods (*Solidago*).

The Umbelliferæ, in their native centres, are plants of the lowlands and plains, as in this country and in central Europe. As they travel southward they find the climate too warm for them, and they have to climb the hills for coolness and fresh air. Wherever they can find hills to climb they can live in Southern lands, but as they get nearer the equator, they must mount up higher and higher, till within the tropics such of them as are found at all are met with only on the lofty mountain tops; just as in Great Britain there are several of the Saxifrages found only on the mountains of Scotland and Wales, which inhabit the lowlands further north in Lapland, Russia, and Siberia.

This group of umbel-bearing plants holds an important place in Economic Botany. From it are derived several powerful drugs, gum-resins, volatile oils, and aromatic seeds, while a number of species are cultivated as esculent vegetables and pot-herbs. Among the drugs are assafœtida, galbanum, ammoniacum, and opoponax; among the aromatics, carraway, coriander, anise, dill, cummin, and angelica; the vegetables are carrots, parsnips, celery, and samphire, with the old-fashioned alexanders and skirret, now rarely used; and the pot-herbs are parsley, fennel, chervil, lovage, and sweet cicely. Their medicinal and aromatic qualities are due to three kinds of secreted juice, viz.: (1) Acrid watery serections which are poisonous. (2) Milky and gum-resinous secretions, which are stimulant and antispasmodic. (3) Aromatic essential oils, which are generally pleasant in flavour. Only those species can be used as food in which secretions of the first two forms are absent.

In carrots and parsnips it is the large accumulation of sugar in the tap-root (about one-twelfth part) which makes them valuable. It has been doubted whether the hemlock (*Conium maculatum*) is really so deadly as it was once supposed to be. The qualities of plants often vary with situation and climate. It is said that in Northern Russia the hemlock is mild, and may be eaten. There is no doubt that it is poisonous in this country, and in more southern climates it may possibly be still more virulent. Celery in its wild state is poisonous also; even when cultivated it is still acrid, though less dangerous than when growing wild, but by blanching the juicy leaf-stalks it is found that the acrid secretion is not formed.

Those Umbelliferæ which naturally inhabit central Europe and Britain, are mostly so much alike that, though it is easy to know that a plant belongs to this order, it is difficult to distinguish one species from another; and this is found to be generally the case in any order which has very sharply defined characters, such as the Labiates, the Sedges, and the Grasses. It is easy enough to see that a certain plant is a grass, but *what* grass? That is often a puzzling question to a young botanist. The species are quite distinct, but the distinctions are subtle and minute. The condition of such an order seems to be something like that of a walled city, in which the number of houses can only increase by crowding close together so that you can scarcely tell one from another. The less marked orders are like open towns, built with wide streets and gardens, and suburbs that stretch out towards one another and often actually meet. The buildings having plenty of room are easily distinguishable, wide spaces being sometimes left between them.

But though these Umbelliferæ are mostly so much alike, there are a few odd exceptions. The sea-holly, the marsh pennywort, the astrantia, and the sanicle, are all quite abnormal, and in some distant countries these strange characters are so exaggerated as to make it difficult to recognise the species as Umbelliferæ at all. Plants of this order are nearly all herbaceous, yet there are a few foreign forms which have a shrubby character. They are generally low-growing plants, seldom exceeding 4ft. or 5ft. high, yet there are a few species which run up to 12ft. or 15ft. The Siberian cow-parsnip, sometimes grown in gardens, has herbaceous stems 8ft. or 10ft. high, and umbels a foot in diameter.

It is curious that while these plants exhibit in their leaves a variety of very beautiful forms, they should have so little to show in the way of blossom. Their flowers are all small and

nearly all white, sometimes with a pink tinge, sometimes greenish, yellowish, or bluish, but always individually inconspicuous, and not showy even when clustered together in the umbels. This probably indicates that in the general system of organic evolution the Umbelliferæ have not yet reached the summit of their wave of life; and it may be that, a hundred thousand years hence, when the woods and fields of Europe shall be annually clothed with a glory of blossom such as we do not dream of now, these plants will lift above the lovely masses of their foliage gorgeous umbels of large bright flowers, rivalling the roses and lilies of to-day.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 152.)

Sub-genus V.—Clitocybe.

59. **Ag. nebularis** *Batsch.* In woods. Rare. Sept.-Oct. The Spring, Kenilworth, *Russell, Illustr.* Sutton; Water's Wood, Maxtoke; Cut Throat Coppice, Solihull.
60. **Ag clavipes,** *Fr.* Woods. Rare. Trickley Coppice, 1888; Harding's Wood, near Maxtoke; Packington Park.
61. **Ag. inornatus,** *Sow.* Amongst grass. Rare. Oct. Birmingham Road, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.*
62. **Ag. odorus,** *Bull.* Moist woods. Local. Aug.-Oct. Oversley Wood, *Purt.* ii., 624. Ragley Wood! *Purt.* iii., 894. Birmingham Road, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* Bentley Park, near Atherstone! *Bloxam,* Sept., 1849. Banks near the entrance to Packington Park.
63. **Ag. cerussatus,** *Fr.* Woods and shady places. Rare. Oct. Near Kenilworth, October, 1850; The Briars, Kenilworth; Field Gate and Red Lanes, near Kenilworth, *Russell, Illustr.* Near Sutton Park.
64. **Ag. phyllophilus,** *Fr.* Amongst leaves in woods. Sept.-Oct. Hedge bank, the Spring, Kenilworth; Crackley Wood! *Russell, Illustr.* Combe Ridings, *Adams.* Sutton Park; Trickley Coppice; Water Orton; Marston Green; Cut Throat Coppice, Solihull; Haywood.
65. **Ag. pithyophilus,** *Secr.* Fir woods. Rare. Sept.-Oct. Combe Abbey Pool, *Adams.* Trickley Coppice; New Park, Middleton.

66. **Ag. candicans,** *Pers.* Amongst leaves in woods. Oct. Burton Green Wood, near Kenilworth, *Russell, Illustr.* Crackley Wood; Kenilworth, collected with Dr. Cooke.

67. **Ag. opacus,** *With.* Grassy places among trees. Very rare. Edgbaston Park, *With.*, 180. Red Lane, Kenilworth, *Russell, Illustr.* "I have found some specimens in Sutton Park, which, I believe, belong to this species." —*W.B.G.*

68. **Ag. dealbatus,** *Fr.* Woods. Rather rare. Oct. Combe Fields, *Adams.* Lower Holly Hurst, Sutton Park; Shawberry Wood, Shustoke.

69. **Ag. gallinaceus,** *Scop.* Pastures. Sept.-Oct. Pastures, Kenilworth, *Russell, Illustr.* Sutton Park.

70. **Ag. fumosus,** *Pers.* Heaths. Rare. Oct. Kenilworth Common, *Russell, Illustr.* Ansty, *Adams.*

71. **Ag. giganteus,** *Fr.* Woods and meadows. Oct. In a meadow, close to a high hedge, at Mr. Bamford's, Middletown, *Purt.* ii., 629. The Dale, Kenilworth, *Russell, Illustr.* Corley, *Adams.*
Fries places this species under *Paxillus.*

72. **Ag. maximus,** *Fr.* Wood borders. Oct. Borders of Crackley Wood, Kenilworth, *Russell, Illustr.* Roadside by Combe Woods, *Adams.*

73. **Ag. infundibuliformis,** *Schæff.* *Ag. membranaceus,* With. Woods. Oct. Local. Edgbaston! Packington Park! *With.*, 159. Crackley Wood, under felled trees in Red Lane, Sept., 1871, *Russell, Illustr.* Gulley Common, near Nuneaton, 1849, *Bloxam.* Combe, *Adams.* Bentley Park; North Waste Wood, Tile Hill; Haywood; Four Oaks; Coleshill Pool.

74. **Ag. geotropus,** *Bull.* Woods. Very rare. Oct. Kenilworth, Sept., 1850, *Russell, Illustr.*

75. **Ag. inversus,** *Scop.* Woods. Not common. Oct. Abbey Hill, Kenilworth; Crackley Wood, *Russell, Illustr.* Combe Road, and Ansty, *Adams.* In clusters, Sutton Park.

76. **Ag. flaccidus,** *Sow.* Woods. Rare. Oct. Discovered by Mrs. Rufford in Ragley Wood, *Purt.* iii., 186 Fillongley, *Adams.*

77. **Ag. catinus,** *Fr.* Woods. Very rare. Crackley Wood Kenilworth! *Dr. Cooke.*

78. **Ag. tuba,** *Fr.* Woods. Rare. Trickley Coppice, Middleton! *Dr. Cooke.*

79. **Ag. cyathiformis,** *Fr.* *Ag. sordidus,* Dicks., With. Meadows. Local. Oct.-Nov. Pastures, Edgbaston,

With., 197. In my own field at Oversley, *Purt.* iii., 197. Combe, *Adams.* Kenilworth, tan heaps; Birmingham Road, Kenilworth, *Russell, Illustr.* Sutton; Sutton Park; Small Heath; Harding's Wood, Maxtoke.

80. **Ag. brumalis,** *Fr.* *Ag. cyathiformis*, Bull.,* With., Purt. Open places in woods. Local. Oct.-Dec. Pastures, Edgbaston, *With.*, 153. Oversley Hill; Coughton Park; Ragley Woods, *Purt.* ii., 623, obs. iii., 182. Burton Green Wood; Crackley Wood, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* Sutton Park; Edgbaston Park; Trickley Coppice; Olton Reservoir; pine wood, Coleshill Heath.

81. **Ag. metachrous,** *Fr.* Woods. Local. Sept.-Oct. Among trees, the Spring, Kenilworth, *Russell, Illustr.* Trickley Coppice; New Park; Middleton Heath; Bradnock's Hayes; pine wood, Coleshill Heath; Whey-porridge Lane, Solihull.

Var. *obsolescens*, Batsch. In the Park at Packington, *With.*, 187. Probably, as he quotes the figure of Batsch (f. 102).

82. **Ag. ditopus,** *Fr.* Pine woods. Rare. Oct. Sutton Park, *Dr. Cooke.* Edgbaston Park; Trickley Coppice; Middleton Heath; pine wood, near Coleshill Pool.

83. **Ag. fragrans,** *Sow.* Woods. Local. Aug.-Oct. Edgbaston Park, under Spanish chestnut trees, *With.*, 158. The Spring, Kenilworth, *Russell, Illustr.* Combe, *Adams.* Coppice, near New Park, Middleton; the Shawberries, Shustoke.

84. **Ag. obsoletus,** *Batsch.* Very rare. Sept. Slope of the boat-house field, Edgbaston, *With.*, 200.

85. **Ag. laccatus,** *Scop.* Woods. July-Oct. Common and very variable. *Ag. rosellus*, With., 167. Edgbaston! *Ag. livido-purpureus*, var. 2, *With.*, 256, and *Ag. subcarneus*, ib. 260, Edgbaston and Packington Parks! *Ag. farinaceus*, Purt. ii., 640, Alcester Heath; side of road to Stratford. Warwick, *Perceval.* Kenilworth, *Russell, List.* Combe, *Adams.* Sutton Park; Trickley Coppice; Bentley Park; Olton, etc., etc.

Var. *amethystinus*, Bolt. Often with the type. Plantations, Edgbaston! *With.*, 176. Oversley and Ragley Woods, *Purt.* ii., 628. Sutton Park; Edgbaston Park; Packington Park; New Park; Coleshill Heath, etc.

* The quotation of "Bull, t. 278, A.B." in Fr. Hym. Eur., p. 103 (repeated by Stevenson, p. 91), is a misprint for t. 248, A.B.

Sub-genus VI.—Collybia.

86. **Ag. radicatus,** *Relh.* *Ag. umbraculum,* With. On bare ground. Local. Aug.-Oct. Church Lane, Edgbaston! *With.*, 158. Plantation, near Dunnington, *Purt.* ii., 637. The Brays, Kenilworth, *Russell, Illustr.* Warwick, *Perceval.* Ansty, *Adams.* Pool Hollies Wood, Sutton Park; Windley Pool; field, near Crackley Wood, Kenilworth; Packington Park; New Park, etc.
87. **Ag. platyphyllus,** *Fr.* Woods. Local. Oct. Sutton Park (*repens*); Trickley Coppice; New Park; Kingsbury Wood; Bentley Park; Marston Green.
88. **Ag. fusipes,** *Bull.* *Ag. elasticus,* With. *Ag. crassipes,* With., Purt. Stumps and under trees. Aug.-Oct. Edgbaston Park, *With.*, 181, 186. Oversley Hill; Spernal Lane, *Purt.* ii., 680, and var. *elasticus,* Oversley Lodge, iii., 199. Birmingham Road, Kenilworth, *Russell, Illustr.* Warwick, *Perceval.* Combe; Corley, *Adams.* Ham's Hall, *Hawkes*! New Park, Middleton; Ironstone Wood, Oldbury; Pool Hollies Wood, Sutton; Packington Park.
89. **Ag. maculatus,** *Alb. et Schwein.* Woods. Not rare. Oct. The Spring, Kenilworth; Crackley Wood! *Russell, Illustr.* Combe Ridings, *Adams.* Sutton Park; New Park; Trickley Coppice; Coleshill Pool and Heath; Ironstone Wood, Oldbury; Four Oaks; Bradnock's Hayes.
90. **Ag. butyraceus,** *Bull.* Woods. Oct. Local. Crackley Wood, Kenilworth, *Russell, Illustr.* Combe Ridings, *Adams.* School Close, Rugby, *Rugby School Rep.* Sutton Park; Water Orton; School Rough, Marston Green; Shawberry Wood; coppice, Whey-porridge Lane, Solihull; Edgbaston Park; New Park; Bradnock's Hayes; Water Orton.
91. **Ag. velutipes,** *Curt.* *Ag. sulcatus,* With. Logs, etc. Frequent. Oct.-Apr. Edgbaston, *With.*, 229. Kenilworth, *Russell, List.* Warwick, *Perceval.* Ansty, *Adams.* Driffold Lane; Sutton Park; near Olton Reservoir; Shirley Heath; Marston Green; Castle Bromwich, etc.
92. **Ag. vertirugis,** *Cooke.* Decayed fern roots. Rare. Crackley Wood, Sept., 1861, *Russell, Illustr.*
93. **Ag. hariolorum,** *DC.* *Ag. nemoralis,* With. Woods. Very rare. Oct. Edgbaston, *With.*, 234.
94. **Ag. confluens,** *Pers.* Amongst leaves in woods. Rare. Binley Woods, near Coventry, *Adams.* Edgbaston Park.
95. **Ag. conigenus,** *Pers.* *Ag. hippopinus,* With. On the cones of Scotch fir, in Packington Park, *With.*, 199.

96. **Ag. cirrhatus,** *Schum.* Amongst leaves. Rare. Combe Ridings, *Adams.* Holly Hurst, Sutton Park; exactly as figured in *Cooke's Illustr.* t. 144B.
97. **Ag. tuberosus,** *Bull.* On dead *Russulæ.* Rare. Aug.-Oct. New Park, Middleton; School Rough, Marston Green; pine wood, Coleshill Heath.
98. **Ag. collinus,** *Scop.* Grassy places. Rare. Sept. The Spring, Kenilworth, *Russell, Illustr.* New Park, Middleton; named by *Dr. Cooke.*
99. **Ag. tenacellus,** *Pers.* Rare. Warwick Castle Grounds, *Perceval.*
100. **Ag. acervatus,** *Fr.* Woods. Rare. Aug. Wood, Dale House Lane, Kenilworth, *Russell, Illustr.*
101. **Ag. dryophilus,** *Bull.* Amongst leaves in woods. Frequent. Aug.-Oct. Edgbaston, *With.*, 284. Ragley Woods; Oversley Wood, *Purt.* iii., 228. Crackley Wood! the Spring, Kenilworth, *Russell, Illustr.* Combe, *Adams.* Sutton Park; New Park; Trickley Coppice; Baddesley Park; Packington Park, etc.

    In Trickley Coppice and near Coleshill Pool there occurs a form of this which appears to be *Ag. aquosus*, Bull.
102. **Ag. rancidus,** *Fr.* Woods. Rare. New Park, Middleton.

    Ag. inolens, *Fr.* Garden, Claverdon Villa, Kenilworth, *Russell, Illustr.*; is probably a mistake.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 159.) M. Nat. Hist. Worc.

* **Rubus Idæus,** 166. Bishop's Wood, near Hartlebury, Bromsgrove Lickey, and Shrawley Wood. S.G.

* **R. glandulosus,** 166. On Bromsgrove Lickey. L.M.

* **Rosa spinosissima,** 165. Near Crookbarrow Hill, in abundance, and about Nunnery Wood, Hallow, and Craycombe. S.G.

* **R. Doniana,** 165. (*Form of R. involuta.*) Craycombe, Crookbarrow Hill, and Battenhall. S.G. *as R. gracilis.*

* **R. villosa,** 165. In Hindlip Wood, near Worcester, and between Bromsgrove and Hagley. S.G. L.M.

* **R. tomentosa,** 165. At Bransford, Fernhill (*Fernall*) Heath, and between Malvern and Cowleigh Park. S.G. L.M.

* **R. Sherardi,** 165. Powick. S.G. (*R. tomentosa, var. subglobosa. Baker.*)

* **R. rubiginosa**, 166. In a hedge between St. John's and Pitmaston. On Ankerdine Hill, and near Crookbarrow. S.G. L.M.

* **R. micrantha**, 166. On the Warren Hill, southward of Little Malvern. S.G. L.M.

R. dumetorum, 166. (*A form of R. canina.*) Between Worcester and Malvern.

* **R. Borreri**, 166. (*A form of R. canina.*) Side of Perry Wood, and in woods near Malvern. S.G. L.M.

* **R. arvensis**, 166. Abundant on the Abberley Hills, and on the Berrow Hill, Martley, &c.

‡ **Mespilus germanica.** Medlar. 164. Exceedingly rare. In a coppice bordering Deehurst Lane, opposite the Lower Lode, near Tewkesbury, a spot almost overgrown with underwood, the lane being merely a rough horse track. The Cynoglossum sylvaticum grows in the same lane. Mr. Lees. *This habitat is in Gloucester.*

* **Pyrus torminalis**, 165. On the red marl cliff at the Ketch, and occupying the dizzy summit of Blackstone Rock, near Bewdley. S.G. L.M.

* **P. domestica**, 165. In the middle of Wyre Forest, near Bewdley. First noticed there by Alderman Pitts, in 1678. Recently visited by Mr. Lees, who reports it to be in a state of decay, and some wood cutters having recently made a fire against its weather-beaten trunk, its destruction seems impending. S.G.

* **P. communis**, 164. Perry Wood. *Worc. Misc.*

* **P. Malus**, 164. Common enough in its genuine austere state. *Worc. Misc.*

* **Œnothera biennis**, 161. Appearing occasionally on suspicious spots within sight of gardens. A single specimen on the bank of the Teme below Powick Bridge. S.G.

* **Circæa lutetiana**, 149. Perry Wood, Shrawley Wood, and other moist shady places. S.G. L.M.

Hippuris vulgaris, 149. Rare. Clifton-upon-Severn. Dr. Streeten.

Ribes Grossularia, 157. A frequent straggler from gardens, and an epiphyte on old willows, but occurring also in less suspicious habitats.

R. rubrum, 156. In the deep dingle of a wood at Hailstone Hill, near Suckley. Also in a ravine at Clifton-on-Teme, between that place and St. Catherine's Well.

R. nigrum, 157. On the banks of the Severn in several places.

* **Sedum Telephium**, 163. Shrawley Wood; marsh close to Laughern Brook, Worcester, and the rocks at Malvern. S.G. L.M.

* **S. album**, 164. On the rocks of the North Hill, Malvern. L.M.

* **S. reflexum**, 164. On the Abbeys at Great and Little Malvern.

* **Cotyledon Umbilicus**, 163. In the fissures of the greenstone and granitic rocks at Malvern. Growing very luxuriantly in a lane leading to the Giant's Grave, at Habberley, near Kidderminster. S.G. L.M.

Saxifraga tridactylites, 162. Adorning the wall fronting the bank of the Teme at Powick Bridge; but the river having now undermined the wall, it has fallen down, and the plant is gone with it.

* **S. granulata**, 162. Not uncommon. In a meadow near Laughern Brook, at Bevere, near Droitwich, Habberley, &c.

* **Chrysosplenium alternifolium**, 162. In a marsh near Leigh Church. Also by a stream in Shrawley Wood.

* **Apium graveolens**, 158. Abundant by the side of the Droitwich Canal.

* **Sium** (*Helosciadium*) **repens**, 158. On the Malvern Hills, among the trickling springs. L.M.

* **S. latifolium**, 158. By the weir at Newman's Bridge, near the Devil's Den, Clifton-on-Teme. Mr. Lees. S.G.

* **S. angustifolium**, 158. Near Bransford Bridge and at Powick Weir. Also by a pool near Bromwich Farm. S.G.

Carum Carui, 158. Meadows near Worcester.

* **Pimpinella Saxifraga**, 158. Dry banks on the Leigh Sinton, and other roads, and elsewhere, very common.

* **P. magna**, 158. On the limestone hills near Suckley.

Bupleurum tenuissimum, 159. Found by Mr. Addison, of Malvern, on the common between Malvern and the Rhydd.

* **Œnanthe pimpinelloides**, 158. In some abundance in a meadow at the north-western base of Crookberrow Hill. Mr. Lees.

* **Œ. Phellandrium**, 158. In a pool on Powick Ham. S.G.

Pastinaca sativa, 159. Road side near Stoughton, abundantly. Battenhall, Craycombe, &c., on red marl and lias marl.

* **Torilis nodosa**, 157. Hedge side on the Spetchley Road. Hedge, road side, near the Ketch, on the Bath Road.

* **Chærophyllum sativum**, 157. In great profusion on the sides of the Tewkesbury Road, just beyond the Turnpike, Worcester. First noticed by Dr. Stokes in 1775. Still there in equal profusion in 1828. Mr. Lees. But in 1830 the road was altered at this point and lowered, the bank thrown down, a wall built, and every vestige of the plant destroyed. S.G.

* **Smyrnium Olusatrum**, 158. In great abundance at Hill Croome, and about Pershore.

* **Adoxa Moschatellina**, 162. By the Paper Mill at Alfrick, but scarce about Worcester. Abundant in the vicinity of Bromsgrove, according to Mr. Maund.

* **Viburnum Lantana**, 159. By the road side at Craycombe. S.G. L.M.

†* **Galium pusillum**, 153. Hedgerow on the side of Red House Lane, Worcester. Dr. Stokes. Now exterminated. *An error. See note to same plant in the "Strangers' Guide."*

* **Asperula odorata**, 153. Woods on the old Storage Hill. Also about Southstone's Rock, and Wassel Hill, near Bewdley. Woods at Stanford, and on Ankerdine Hill. S.G. L.M.

* **A. cynanchica**, 153. Bredon Hill. Dr. Streeten.

* **Valeriana rubra**, 150. On the wall close to the western entrance of Worcester Cathedral, 1826. The plant has since disappeared. S.G.

* **V. dioica**, 150. In a marshy field close to Laughern Brook, near Worcester, above Bubble Bridge. S.G.

* **V. officinalis**, 150. Nunnery Wood, and the banks of the Severn. The narrow-leaved variety on Bredon Hill. S.G.

* **Dipsacus pilosus**, 152. In great abundance by the side of the lane below the Abbey Church, Malvern. Brook at Kempsey. S.G. L.M.

* **Scabiosa succisa**, 152. Moist pastures near Worcester. S.G.

* **Carduus Marianus**, 174. On the marly bank by the side of the London Road, at Red Hill, near Worcester.

* **C. acanthoides**, 174. In the hedges near the Severn, below Worcester.

* **C. eriophorus**, 174. On the road from Worcester to Norton. Mr. Lees.

* **C. pratensis**, 174. By the brook at Upton Snodsbury.

* **C. acaulis**, 174. On Welland Common, near Little Malvern.

* **Carlina vulgaris**, 174. On the Malvern and Abberley Hills, &c. L.M.

* **Serratula tinctoria**, 174. Borders of Perry and Nunnery Woods, &c. Abundant on the bank at Rainbow Hill, previous to the alteration of the road.

Matricaria Chamomilla, 175. On Welland Common, and other waste spots about the eastern base of the Malvern Hills.

* **Tanacetum vulgare**, 174. Very abundant on the banks of the Severn and Teme.

* **Anthemis nobilis**, 175. On the Link, at Great Malvern, and on other commons about the Hills. L.M.

Achillæa Ptarmica, 175. Corn field at the Rhydd. Dr. Streeten. Also at Battenhall and Little Malvern.

Artemisia Absinthium, 174. About Malvern and Alfrick, near farm houses. *Recorded by Scott without locality.*

* **Gnaphalium rectum** (*G. sylvaticum, L.*), 175. In Shrawley Wood. Mr. Lees.

* **Bidens cernua**, 174. Ponds in the vicinity of Martley. In a ditch near Pitmaston.

* **Inula Helenium**, 175. In the meadow at the back of Mr. Harris's Farm House, near Stanford Bridge, between Clifton and Stanford, according to the late Mr. T. B. Stretch, of Worcester.

* **Solidago Virg-aurea**, 175. On the rocks at Malvern, and in the adjacent Woods. Coppice near Bewdley. L.M.

Tussilago Petasites (*P. vulgaris, Desf.*), 175. Rather local upon the banks of the Teme. By the side of the brook at Alfrick. Banks of the Severn opposite Cleveload. Skirting the entire course of the brook at Sapey.

* **Cichorium Intybus**, 174. Border of a corn field near Pendock. Dr. Streeten. Also near Crookbarrow Hill.

*† **Hieracium murorum**, 174. On the rocks at Malvern. L.M. *An error, I think, for H. vulgatum.*

* **Jasione montana**, 155. In Shrawley Woods, and other sandy places.

*† **Campanula glomerata**, 155. Near Knightford's Bridge. S.G. (*Must be an error.*)

* **C. latifolia**, 155. Shrawley Wood, where the sandstone cliff shelves down towards the Severn.

* **C. patula**, 155. Abundant in the hedges about Newtown, and in almost all our woods. S.G.

* **Vaccinium Oxycoccos**, 161. Bogs on Bromsgrove Lickey.

* **V. Myrtillus**, 161. Abundant in Bewdley Forest and on the Bilberry Hills, Bromsgrove Lickey. Also on rocks on the Malvern Hills, but sparingly there. L.M.

† **Menziesia polifolia**, 161. On the Lickey Hill near Bromsgrove. Mr. Lees. It is to be feared now extirpated, the road having since been altered. (*Must be an error.*)

* **Erica Tetralix**, 161. Abundantly on Bromsgrove Lickey, but not on any part of the Malvern Range.

* **E. cinerea**, 161. Bromsgrove Lickey, and various heaths in the northern parts of the county.

* **Pyrola media**, 162. Wyre Forest, near Bewdley. Dr. Pratinton.

* **P. minor**, 162. Shrawley Wood. Mr. Lees.

* **Monotropa Hypopitys**, 162. At the roots of the beech trees in the plantations at Middle Hill, Broadway. Sir Thomas Phillips, Bart.

Ligustrum vulgare, 149. Abundant in the hedges.

* **Vinca major**, 157. Between Cotheridge and Broadwas, by the road side. Hedge bank, near Little Malvern Church. S.G.

* **V. minor**, 157. In the woods near Leigh Sinton, unquestionably wild. Hedge bank at Little Malvern. Also in profusion at the base of Crookbarrow Hill. S.G.

* **Chlora perfoliata**, 161. At Craycombe, Abberley, Clifton, &c. L.M.

* **Gentiana Amarella**, 157. On the wooded limestone ridge at the western base of the Worcestershire Beacon, Malvern. L.M.

* **Menyanthes trifoliata**, 154. In a pool on Hartlebury Common.

* **Cuscuta europæa**, 157. Very rare. At Shipston-on-Stour, according to the Rev. Dr. Jones. *This is the record in Smith's "English Flora," 1824.*

* **Datura Stramonium**, 156. Occasionally appearing on manured soil, near Worcester, but not really a native. S.G. L.M.

* **Atropa Belladonna**, 156. Dudley Castle. Also on a wall at Lincombe, near Hartlebury, where it has flourished for many years, according to Dr. James Nash.

(*To be continued.*)

NOTES UPON THE RECENT OCCURRENCE OF PALLAS' SAND GROUSE.*

BY R. W. CHASE.

At the end of last month another irruption of Pallas' Sand Grouse, *Syrrhaptes paradoxus*, took place in this country, similar to that which occurred in 1863. Curiously enough, the date of their arrival on the present occasion was almost identical with that of twenty-five years ago.

Professor Newton intimated that in all probability another invasion would take place, as he considered that the cause of this species appearing in Europe was the inordinate increase in their natural habitat—the Steppes of Tartary; and that unless some unforeseen circumstance checked their increase, we might expect another immigration of their surplus, which prophecy has been amply fulfilled during the last few weeks.

I cannot help thinking that the cause of this Asiatic species visiting Europe is more likely to be some climatic influence, such as wind or extreme cold, which diverted the flocks when moving to their breeding stations, and caused them to look for a suitable district in another direction; because if it were a matter of surplus population only, surely their hereditary habitat would become over-stocked within a less period than twenty-five years.

Pallas' Sand Grouse is an attractive species, irrespective of its rarity in our islands, possessing some most interesting characteristics, especially the formation of the foot, in which the toes are united together, forming a sole with a rugous horny covering, the hind toe being wanting, and the legs are completely feathered down to the toes. The power of flight must be immense, judging from the elongation of the primaries and depth of keel of sternum. I have received numerous letters informing me of the occurrence of these Sand Grouse in different parts of the country, and as it is desirable to obtain as complete a record as possible, perhaps the following may be of interest:—On the 18th of May, a male shot at Welwich, near Patrington, out of a flock of about twenty. On the 22nd, a female shot at Spurn, out of a flock of seven, and same day seven were seen on the Denes at Yarmouth. On the 24th, a female shot at Rough Hills, Wolverhampton. On June 1st, a flock on Holy Island, of which several were shot. Same day four were shot at Horsey, Norfolk. On the 2nd, fourteen were seen at Fleg

* Read before the Birmingham Natural History and Microscopical Society, 12th June, 1888.

Burgh; also, a small flock on the Denes at Yarmouth. On the 5th, a female was shot in Shropshire. On the 7th, a female shot near Flamborough, and a male the following day at same place. I also have had word sent me that a nest containing three eggs has been taken in Norfolk, showing that if protection were afforded them the Sand Grouse would breed here; and if it should be possible to acclimatise them they would be a valuable addition to our avifauna, feeding as they do upon small seeds and grasses—not grain, at least I have found none in those crops I have examined,—and would probably assist in destroying noxious weeds.

BOTANICAL NOTES FROM SOUTH BEDS.

Amongst the self-imposed duties of an observer of nature are included careful records of the appearance of alien and the extinction of native plants. The latter, to put it mildly, is a less agreeable task than the former, and it is to record an instance of this kind that these notes are made. During the last few years rumours have been rife that it was intended to enclose much of Totternhoe Common land, and a visit during the present month of May, 1888, has revealed changes that, although they might appeal sympathetically to the utilitarian spirit of the age, yet evoke feelings of keen regret from the lovers of nature's quiet haunts. One could forgive the diversion of tortuous roads, the stoppage of little-used paths, but the conversion of a favourite haunt of some of our rarest native plants into an arable field, implies an irreparable loss from a naturalist's point of view. Lying between Totternhoe and Eaton Bray, there has existed a low, boggy meadow, which is now in the course of being turned into arable land. An enumeration of some of its more striking plants will give some idea of the richness of its organic contents. Such are *Anagallis tenella*, *Parnassia palustris*, *Pinguicula vulgaris*, *Menyanthes trifoliata*, *Orchis latifolia*, *Carex panicea*, *C. binervis*, and last, which is the most noteworthy, *Hypnum Sendtneri*, for it is to be feared that this rare moss must now be regarded as extinct in the county of Beds. Of the other plants, the Bog Pimpernel and the Butterwort, there are in this county at least one other station for each, viz., Heath and Reach for the former, and Markham Hills for the latter. On carefully examining the upturned sods of the Totternhoe mead, one detected at the visit in question some half dozen plants of the *Pinguicula*, which were carefully removed to an adjoining meadow, which is enclosed as a pasture, where it is hoped they will continue to exist. But of *Hypnum Sendtneri* not a trace could be found, as the ditch in which it grew was filled with soil. As a further illustration of the varied forms of life of this field, it may be mentioned that the surface of the prepared soil was literally strewn with the blanched shells of molluscs, chiefly consisting of *Succinea elegans*, *Carychium minimum*, *Helix hispida*, *H. sericea*, *H. pulchella*, and *Cochlicopa lubrica*. There was a small compensating record made on the same occasion that somewhat diminished one's regret, viz., the occurrence, in an adjoining meadow, of *Polygonum bistorta*, which was known only to grow near Luton in S. Beds, in a field that will probably soon be built upon.

JAS. SAUNDERS, Luton.

Wayside Notes.

We observe that Mr. Chas. B. Plowright, of King's Lynn, the well-known micro-fungologist, proposes shortly to publish an account of the British Uredineæ and Ustilagineæ. The work, which will be published as soon as the requisite number of subscribers has been obtained, besides containing descriptions of the British species of these fungi, will also give a full account of their biology (as far as this is at present known), including the methods of observing the germination of their spores, and of their experimental culture. The publishers are Messrs. Kegan Paul, Trench, and Co.

Amongst the newly-elected Fellows of the Royal Society we are very glad to recognise two local scientists, viz., Professor Poynting, D.Sc., and Professor Lapworth, LL.D., F.G.S., both of the Mason College, Birmingham. The physical work of the former of these lies outside the sphere of criticism of the "Midland Naturalist," though, as secretary to the Birmingham Philosophical Society, his name is well known to many of our readers; Dr. Lapworth, however, is *par excellence* a field naturalist, and in the Midland district, as in North and South Scotland, has done much good work in unravelling vexed geological questions.

Attention has been drawn in the *Times* and other papers to the serious defoliation of the oak in many districts through the ravages of a small blackish-green caterpillar. These ravages are particularly noticeable in the park at Sutton Coldfield, where large masses of the trees are as leafless as in mid-winter. Walking through the woods in the first week in June, the caterpillars were seen to hang literally in ropes from the trees, and an open umbrella was the only way in which progress could be made possible to ladies.

Speaking of trees, probably most of our readers have noticed the extraordinary abundance this year of the flowers of the holly. In many bushes the leaves have been, at a few yards distance, completely lost sight of amongst the dense tufts of the whitish flowers. If the promise of the spring is fulfilled in the autumn, berried holly ought next Christmas to be a drug in the market, and, according to the popular superstition, the approaching winter ought to be one of marked severity. Possibly, though, the relative poverty of hawthorn flowers may correct the prevalence of those of the holly, and we may be favoured with an open winter after all.

It is interesting to note that this year the flower known, sarcastically no doubt, as "May," did not put in an appearance till the end of that month, and was not in full beauty in the central Midlands till mid-June. In full accord with this, however, the writer of these notes picked his last Poet's Narcissus, just expanded, on Midsummer day.

We hope our readers will not forget the meeting of the Midland Union of Natural History Societies, at Northampton, on July 4th and 5th, but will take care to make it as successful in point of numbers as it seems certain to be in point of interest. We are requested to mention that the price of tickets for the Botanical and Geological Excursions will be 7s. 6d. each; not 8s. 6d as stated last month.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Biological Section, May 8th. Mr. W. B. Grove, B.A., in the chair. The following were exhibited by Mr. W. B. Grove:—Fungi, *Puccinia liliacearum*, from Lytham, *Peronospora valerianellæ*, new to Britain, and *P. Lamii*, from Kirkbride, collected by Rev. Hilderic Friend; for Mr. S. Bolton, *Pocillum Boltonii*, a new and interesting aquatic fungus, first found by the late T. Bolton at Hill Oak, near Sutton. By Mr. Collran Wainwright, Lepidoptera: *Hibernia progemmaria*, *H. defoliaria*, *Bombyx neutria*, *Miana strigilis*, to show variation, and *Sphinx Convolvuli*. By Mr. J. E. Bagnall, a number of mosses and lichens from Preston Bagot, including *Scleropodium cæspitosum* in fruit; for Rev. D. C. O. Adams, M.A., *Hypnum glareosum* and other mosses, from Bournemouth; for Mr. S. Walliker, *Hookeria lucens* from Cwm Rhaiadr, North Wales; for Father Reader, a number of mosses and hepatics from Woodchester, Gloucestershire. The President, Mr. W. B. Grove, then read a paper by Rev. W. Hunt Painter, "Notes on the Flora of Settle," illustrated by specimens. The paper gave an interesting account of a part of Yorkshire, formerly worked by Mr. John Windsor, F.L.S., and later botanists, to whose record Mr. Painter was able to make several additions. A discussion followed, in which Messrs. W. B. Grove, C. Pumphrey, and J. E. Bagnall took part, and a vote of thanks was accorded to Mr. Painter for the trouble he had taken in preparing and illustrating the paper.—June 12th. Mr. R. W. Chase in the chair. The following were exhibited:—By Mr. W. B. Grove, B.A., for Mr. W. R. Hughes, *Peziza coronaria*, a beautiful cup fungus, the largest of its kind in Britain. By Mr. Herbert Stone, *Geranium sylvaticum*, *G. lucidum*, *G. columbinum*, *G. sanguineum*, *Teesdalia nudicaulis*, *Sedum Rhodiola*, and many other rare plants, from various localities. Mr. W. P. Marshall, M.I.C.E., *Pavia flava*, or smooth horse chestnut, a native of Georgia. Mr. C. Pumphrey, an abnormal *Antirrhinum majus*, in which the lower lip of corolla was divided into three distinct petals; a series of Aquilegias, in which a wonderful variation in duplication and suppression was noticeable; also, a beautiful series of Swiss Alpine plants, including *Edelweiss*. Mr. R. W. Chase, *Syrrhaptes paradoxus*, the sand grouse, male and female, with a very interesting account of the habits and distribution of these birds. Mr. J. E. Bagnall, A.L.S., flowering plants, mosses, and lichens, from the Stour, Alne, and Cherwell basins in Warwickshire; for Rev. D. C. O. Adams, a fine series of mosses, including *Ulota intermedia* and *Hypnum loreum*, from near Tetsworth, Oxfordshire; for Mr. Walliker, *Scilla verna*, *Armeria maritima*, and mosses and lichens, from Land's End; for Father Reader, *Graphis elegans*, *Sticta pulmonaria*, and other lichens, from near Woodchester, Gloucestershire. Mr. W. B. Grove then read his paper, "Notes on some Plants of the Rhine Land," illustrated by a beautiful series of specimens; the paper was full of interest, and elicited a discussion, in which Messrs. Chase, Pumphrey, Waller, Wilkinson, Marshall, and Bagnall took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 28th. Mr. J. Madison exhibited land and freshwater shells, collected at Weston-super-Mare; also specimens of *Pisidium amnicum* from Hopwood; Mr. Hopkins, a collection of shells, made in

the Edge Hill district; Mr. J. Collins, a collection of plants from Bewdley, including *Lathræa squamaria*, parasitic on a poplar, and *Saxifraga granulata*. Under the microscopes, Mr. J. Madison, palate and upper jaw of *Helix pomatia;* Mr. Corbet, circulation in a stickle-back.—June 4th. Mr. J. Madison exhibited a specimen of *Limax agrestis* var. *albida;* Mr. Deakin, a collection of shells from Gloucestershire, including specimens of *Bulimus montanus* and *Clausilia Rolphii.* Under the microscope, Mr. Moore, *Anguillula aceti*, the vinegar eel. Mr. Dunn showed a nodule of flint of which a fossil echinus was the nucleus.—June 11th. Mr. Corbet showed slabs of Keuper marlstone, from Adderley Park Road, with ripple marks and pseudo-morphs of salt crystals; Mr. J. Madison, a curiously distorted specimen of *Planorbis spirorbis*. Mr. Rodgers, under the microscope, *Pandorina morum*. Mr. J. W. Neville then read a paper on "Drawing Microscopic Objects." The writer said all who worked with the microscope found out the necessity of making drawings of some objects they examined, if any permanent records of them were to be kept. This necessity increased exactly as the facilities for preserving objects diminished. In illustrating any subject connected with microscopy, the real objects should be shown where practicable; when they could not, drawings must do duty for them. The writer glanced at the different kingdoms of nature, and showed where drawings were of little use and where important, and remarked that we were largely indebted to the draughtsman for our knowledge of "pond life." The slight but carefully executed drawings, issued by the late Mr. Thomas Bolton, would be familiar to all as models of accuracy and care. The various appliances for drawing objects were reviewed at length, and preference given to Beale's Neutral Tint as being simple in form, economical in price, and easy to use. The process of drawing objects was shown, and a few hints on the preparation of magic-lantern slides given. The paper was illustrated by a large number of drawings.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY AND FIELD CLUB.—The Annual Meeting of this Society was held in the Museum, Dudley, on the 16th May, the president, Mr. Horace Pearce, F.L.S., F.G.S., in the chair. The yearly report of the committee and statement of accounts were presented and adopted, and the officers for the present year elected; Mr. H. Pearce being re-elected as president. After the conclusion of business, the party visited the Earl of Dudley's openwork at Claycroft, near Tipton, where a fine exposure of the South Staffordshire thick coal, which here attains the extraordinary thickness of fourteen yards, has been stripped of the overlying few feet of earth and rubble, and is being quarried in open daylight. This fine seam of coal, so close to the surface, was worked at an early age of mining by most primitive means, the miners sinking shallow pits and hollowing out the coal round the bottom as far as they ventured to go, having no means of clearing the pits from the water which percolated through from the surface. These old pits are locally termed "bell-pits" from their shape, and may be seen, filled up with surface rubbish, along the line of outcrop of the coal measures and at Claycroft. The party then proceeded to Coseley to examine a bed of ironstone lying a few feet above the thick coal, and the nodules of which contain remains of ferns, insects, crustaceans, &c., in an excellent state of preservation. Mr. Madeley exhibited from this bed a fine collection of ferns, including *Alethopteris lonchitica*, *Neuropteris gigantea*, *N. heterophylla*, together with large specimens of *Cyclopteris tricomanoides*, which is now generally considered to be part

of *N. heterophylla*. Mr. Madeley also exhibited some fine wings of neuropterous insects, *Brodia priscotincta*, which retain the patches of colouring that their wings displayed in life; also specimens of a large spined myriapod, *Euphoberia ferox*, and three species of Limuli, viz.:—*Bellinurus bellulus*, *B. Kœnigianus*, and *Prestwichia rotundata*. The Society held their second Field Meeting on Tuesday, the 12th June, at Pontesbury, near Shrewsbury, for the purpose of examining the Uriconian (Archæan) rhyolites of that neighbourhood, discovered and described by Dr. Callaway. Alighting at Plealey Road Station, the party first examined the exposures of these devitrified lavas on the north flank of Pontesford Hill, and then walked to Lyd's Hole, a pretty little glen with cascade, where good specimens of rhyolite containing specks of chalcedony and showing the lava-flow were obtained. Just above the waterfall a band of the rock was found which showed a spherulitic structure, as described by Dr. Callaway in the "Quarterly Journal of the Geological Society" for May, 1882. Lower down the brook was found a bed of Lower Caradoc shale, which was pointed out by the same observer, from which were obtained *Asaphus Powisii*, *Trinucleus concentricus*, *Orthis testudinaria*, and *Diplograptus pristis*. The following plants were determined by Dr. Fraser, viz.:—*Geranium lucidum*, *G. dissectum*, *Cotyledon umbilicus*, *Sedum telephium*, *S. Fosterianum*, *Teesdalia nudicaulis*, *Cynoglossum officinale*, *Linaria cymbalaria*, *Poa nemoralis*, *Asplenium adiantum nigrum*, *A. trichomanes*, *Polystichum angulare*. The following freshwater and land shells were collected by Mr. Morgan (Welshpool):—*Limnæa peregra*, *Planorbis albus*, *P. nautileus*, *P. nitidus*, *Ancylus lacustris*, *A. fluviatilis*, *Pisidium pusillum*, *Helix rotundata*, *Zonites crystallinus*, *Limax agrestis*.—An afternoon Field Meeting was held on Saturday, the 23rd inst., at Walsall, to examine the Llandovery sandstone and Woolhope (Barr) limestone in that neighbourhood. The members first drove to see the Wenlock shale, which is to be seen close by the canal on the Birmingham Road, where *Heliolites Grayi*, a coral peculiar to this shale was found, together with *Encrinurus punctatus*, and other fossils. The drive was then resumed to a small exposure of Llandovery sandstone, the oldest rock to be found in South Staffordshire, some parts of which are highly fossiliferous, yielding several species of Pentamerus, and also Strophomena, Petraia, Encrinurus, Ptilodictya, &c., but as the rock is a coarse grit, only the casts are preserved, and they are very fragile. Mr. Symons (Walsall) exhibited a good collection of fossils from this bed obtained by his own hammer. The party then went to the old quarries of Woolhope (Barr) limestone, and noticed the concretionary layers of limestone alternating with soft shale, but were not successful in finding more than a few small brachiopoda. The botanists found a few interesting limestone plants on the banks. The Society will hold the following Field Meetings during the season:— July 4th and 5th, Northampton, Annual Meeting of Midland Union of Natural History Societies; July 23rd, Bredon Hill; August 22nd, Brown Clee Hill or Ankerdine; September 18th, Rock near Bewdley.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. Evening Meeting, Wednesday, June 20th; attendance, eight. The chairman reported that the excursion last week to Swithland Wood was attended by six members. It was wet and little was done, but in the wood a moss new to the county was collected (*Brachythecium salebrosum*). *Cotyledon umbilicus* was found in flower, and large banks

of wild strawberries. The party were handsomely entertained on their way home by Rev. T. A. Preston, at Thurcaston Rectory. The oaks in the wood were much devoured by the caterpillar of the Oak Egger. Exhibits: Specimen of *Brachythecium salebrosum*, by the chairman; curious branched frond of the *Ceterach* fern, by Mr. G. C. Turner; leaves of the variegated Negundo maple, by Mr. Headley. Mr. Knowles reported that damson trees were much damaged in their foliage this year, apparently by the high winds. Dr. Finch confirmed this. A short discussion took place on the question, "What causes the Caterpillar to change into a Butterfly?" The chairman pointed out that, though there might be no greater difficulty in this question than in many similar ones in the science of biology, yet this was a peculiar case, because the caterpillar was a complete living animal, which without any external cause went to sleep, and by an extraordinary change in its muscles, mouth, limbs, skin, and clothing, woke up an entirely different creature. Where, in the caterpillar, was the *plan* of the butterfly, and the power to produce it?

SEVERN VALLEY NATURALISTS' FIELD CLUB.—The first Field Meeting of the season 1888 took place at the Wrekin, and was attended by between forty and fifty members. At the large quarry at the foot of the Wrekin, Dr. Callaway gave a brief sketch of the progress of discovery in the district, referring first to Mr. Allport's determination of the true nature of the igneous rocks of the Wrekin. The bedding of the rock in the quarry was pointed out, and its structure as a normal felspathic ash was shown on hand specimens. The steps of further investigation from the discovery of the Cambrian age of the Shineton shales, with the underlying Hollybush sandstone, and the still older Quartzite, resting discordantly upon the volcanic series, led to the conclusion that the last-named was of pre-Cambrian (Archæan) age. To this great volcanic group the name "Uriconian" (from the Wrekin) was given. The great antiquity of the Uriconian rocks was further confirmed by the fact that the conglomerates and grits of the Longmynd, which were at least as old as Lower Cambrian, were largely derived from them. Evidence of a still more ancient formation was supplied by the Uriconian conglomerates of the district. In these were found rounded pebbles of many kinds of hypogene rock, such as were seen at Primrose Hill and the Ercal. These were the true "Bottom Rocks." They were similar to the Crystalline rocks of Malvern (Malvernian), and to the gneisses which went by the names of "Hebridean" and "Laurentian." At the summit of the Wrekin the lavas (Rhyolites) of the Uriconian series were pointed out, and the general geology of the district was described. Many of the readers of the "Midland Naturalist" are already familiar with Dr. Callaway's discoveries from the Journal of the Geological Society of London. After ascending to the summit and returning *viâ* the cottage, carriages, kindly sent by Dr. Cranage, of the New Hall, were in waiting, and conveyed the party to his residence, where a most sumptuous dinner was provided. The secretary, the Rev. R. C. Wanstall, R.D., Vicar of Condover, proposed fourteen new members, and on the proposition of the Rev. H. J. Ward, Vicar of Morville, seconded by Mr. Homfray, and warmly supported by the hon. secretary, Dr. Callaway was elected president of the Club. The learned doctor, in accepting the office, said his aim and object would be to assist the members in the investigation of science.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ELEVENTH ANNUAL MEETING, NORTHAMPTON, JULY 4TH AND 5TH.

The Eleventh Annual Meeting of the Midland Union, which was held at Northampton, on the 4th and 5th July, will be remembered, by those who were fortunate enough to be present, as one of great interest and enjoyment. The arrangements which the Northamptonshire Natural History Society and Field Club had made for the comfort and convenience of the visitors were excellently carried out, the hospitality so courteously extended was appreciated to the full, and altogether the Meeting was quite a successful one. The Northampton Society had arranged for the holding of the Soirée and one of the Excursions in conjunction with the Annual Meeting of the Northamptonshire Architectural Society, and this gave the members of the Midland Union unusual facilities for the study of the fine churches visited on the 5th.

Delegates were present from the following Societies:—Birmingham Natural History and Microscopical Society, Birmingham Philosophical Society, Birmingham and Midland Institute Scientific Society, Northamptonshire Natural History Society and Field Club, Oswestry and Welshpool Naturalists' Field Club, Oxfordshire Natural History Society and Field Club, Rugby School Natural History Society, Tamworth Natural History, Geological, and Antiquarian Society.

The principal business of the Council, over which the Rev. S. J. W. Sanders, D.D., presided, was to receive the report of the adjudicators for the Darwin Medal, and to determine on the award. The Report to the Annual Meeting was discussed and adopted, and a general discussion on the affairs of the Union took place.

The General Annual Meeting was held in the Old Museum Room, under the presidency of the Rt. Hon. Earl Spencer, K.G., who, in welcoming the Union to Northampton, gave an interesting address on the value of a general and intelligent study of Natural History as an addition to the enjoyment and interest of every-day life. In some later remarks he deplored the reckless killing of our native birds, instancing the Heronry at Althorp, and his constant fear lest the Herons should leave the place or be completely exterminated.

The Rev. H. H. Slater, of the British Ornithologists' Union, delivered an address on "Insularity," which will be published in a subsequent issue of the "Midland Naturalist."

The Report from the Council announced that the Darwin Medal had been awarded to Mr. J. E. Bagnall, A.L.S., for his paper on the "Flora of Warwickshire," which all readers of the "Midland Naturalist" will remember as appearing from time to time in its pages.

Mr. Bagnall was unfortunately not able to be present, so that the Medal was received on his behalf by Mr. W. R. Hughes. The Report, which is appended, will show the high estimate which the adjudicators formed of Mr. Bagnall's work.

The Treasurer's Report showed a satisfactory state of the finances of the Union, there being an *estimated* balance in hand, some accounts not having yet been paid, of about £16.

It was reported that no invitation had been received for the Meeting in 1889, so that the matter was left in the hands of the Executive Committee.

Votes of thanks were passed to the Officers for the past year; to the Northampton Society for the excellent preparations for the Meeting; and to the Chairman. The Editors of the "Midland Naturalist" were re-elected, as also the Treasurer and Secretary.

The Conversazione in the Town Hall was very interesting, although the attendance was not so large as had been hoped for, a fact which was probably largely due to the very stormy weather.

Papers were read during the evening by Mr. H. M. J. Underhill, of Oxford, on the "Eyes of Insects," and by Mr. Beeby Thompson on the "Jurensis Zone of Northamptonshire." At the same time the Architectural Society held its annual meeting, at which several papers of great archæological interest were read.

The whole of the arrangements were carried out in an admirable manner by the local Societies, and those who were present expressed their great pleasure at both the collections and the papers.

The Excursions on the 5th of July were carried out according to the programme, with the exception of the Geological one, which did not take place.

The Botanical Excursion resulted in the discovery of a new Moss, *Leucobryum glaucum*, and a red variety of *Usnea barbata* was obtained.

Those who joined the Archæological Excursion had the opportunity of inspecting the very interesting churches at Higham Ferrers, and Rushden, with the quaint parvise over the north porch in which, within living memory, an old woman used to live, having to ascend to her room by a ladder;

Irchester, Castle Ashby, and Earl's Barton, the latter being a fine example of an Anglo-Saxon church.

The weather, fortunately, interfered with the Excursions less than might have been feared, and the visitors brought away very pleasant memories of the kindness and forethought which had made the Eleventh Meeting of the Union so successful and enjoyable.

THE REPORT OF THE COUNCIL.

Societies composing the Union.

During the past year the Oxfordshire Natural History Society and Field Club has entered the Union.

The Council, however, regrets that the Evesham Field Naturalists' Club is reported to be abandoned, and that no communications have been received as to the Nottingham Working Men's Naturalists' Society either last year or this, so that we must remove that from our list which will now stand as follows, the Peterborough Natural History and Scientific Society having also left the Union in accordance with the notice received last year:—

Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Leicester Literary and Philosophical Society.
Malvern Field Club.
Northamptonshire Natural History Society and Field Club.
Oswestry and Welshpool Naturalists' Field Club.
Oxfordshire Natural History Society and Field Club.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.
Tamworth Natural History, Geological, and Antiquarian Society.

Darwin Medal.

The subject for which the Darwin Medal is awarded this year is Botany, and the papers which have appeared in the "Midland Naturalist," and were eligible for the competition, were submitted to the following gentlemen who kindly acted as adjudicators, viz.:—Professor I. Bayley Balfour, F.R.S.; Maxwell T. Masters, M.D., F.R.S.; Spencer Le Marchant Moore, Esq.; William Mathews, M.A.; and Professor W. Hillhouse, M.A., F.L.S.; the services of the last named being made possible by the fact that, in deference to his strongly expressed desire, the Committtee reluctantly consented to withdraw a paper, contributed by him, from the list to be submitted to the adjudicators.

The Reports received from the Adjudicators were unanimous in speaking very highly of Mr. J. E. Bagnall's paper on the "Flora of Warwickshire," such expressions being used as "a solid contribution to scientific knowledge," "preeminently the kind of investigation which the Darwin Medal was instituted for the purpose of encouraging, and they alone are sufficient justification for the existence of the

Medal." "Evincing great industry in an important, although, at the present time, somewhat unpopular branch of the Science." But one of the five did not consider that the work came under the head of "original work," and so did not venture to recommend the award of the Medal.

In accordance with the opinions received the Council has awarded the Darwin Medal for this year to Mr. J. E. Bagnall, A.L.S., for his "Flora of Warwickshire," and various other papers bearing on parts of the same subject.

"MIDLAND NATURALIST."

The "Midland Naturalist" has been published regularly, and the papers which have appeared in it have been of great interest and value.

Some of the principal papers are as follows:—

On the Measurement of the Magnifying Power of Microscope Objectives, and a Note on the Recent Riviera Earthquake, by W. P. Marshall, M.I.C.E.; Colour Reaction, with special reference to Botanical and Microscopical Investigations, by W. H. Wilkinson; Passages from Popular Lectures, by F. T. Mott, F.R.G.S.; Volition, by Constance C. W. Naden; Botanical Notes and Conchological Notes from South Beds, by Jas. Saunders; Notes on a New Zealand Rock, and on the Dust Ejected in the Eruption of Tarawera in June, 1886, and a Note on the Occurrence of Gold at Mount Morgan, in Queensland, by Thomas H. Waller, B.A., B.Sc.; Notes on the Valley of the Warwickshire Stour and its Flora, and a New British Moss, by J. E. Bagnall, A.L.S.; The Discomycetes of the Birmingham District, by W. B. Grove, B.A.; The Fungi of Warwickshire, by W. B. Grove, and J. E. Bagnall; The Recent Landslip at Zug, by William Pumphrey; On some Aids rendered by Photography to Geology, by W. J. Harrison, F.G.S.; Some Investigations into the Function of Tannin in the Vegetable Kingdom, by Professor W. Hillhouse, M.A., F.L.S.; Individualism in Art, by W. K. Parkes; The Present and Future of Science Teaching in England, by Professor W. Hillhouse, being his retiring address as President of the Birmingham Natural History and Microscopical Society; Notes on the Climate of South Queensland, by Clement L. Wragge, the Government Meteorologist of Queensland, to whose labours the "Midland Naturalist" was for some years indebted for Meteorological Notes; William Mathews, M.A., has been publishing a History of the County Botany of Worcester, and B. Thompson, F.C.S., F.G.S., has continued his paper on the Water Supply from the Middle Lias of Northamptonshire.

At the last Annual Meeting the Council adopted a resolution appealing to the various Societies of the Union for more support for the "Midland Naturalist" in the way both of getting more subscribers, and also in the furnishing of papers. They believed that, even for those Societies which publish their own transactions separately, abstracts of papers read and notes of observations recorded would, in many cases, be of great value if published in the "Midland Naturalist," and would increase the general interest in the Union among the members, as well as facilitate their studies.

The Societies composing the Union differ considerably in character. Some of them are Field Clubs only, or, at any rate, the meetings for the reading and discussion of papers and exhibition of specimens are quite subordinate to the excursions, although at these explanatory papers are frequent. Others have meetings for papers and exhibitions, but have no published record of them. Two of the Birmingham Societies give abstracts and reports of their meetings in the "Naturalist," while the Birmingham Natural History and Microscopical Society use

the Journal for the publication of their entire proceedings, and provide a copy for each member monthly. Hence, the list of papers previously given really serves as a report of the transactions of the Birmingham Natural History Society and but little more. The Council again urges upon the component Societies, especially those which do not publish separate transactions, at whose meetings nevertheless there must be a considerable amount of original matter produced, to make more use of the means which the "Midland Naturalist" provides for publication in such a simple yet efficient manner.

In the transactions of the Societies which publish separately we may mention, from the Transactions of the Leicester Literary and Philosophical Society—A Paper on the Roman Pavement in Jewry Wall Street, Leicester, by William Jackson; The Aylestone Sandpit in the Soar Valley, by C. A. Moore, M.D.; The Songs of some Leicestershire Birds, by F. T. Mott, F.R.G.S.; A Note on the Grained Structure of Matter, by Rev. E. Atkins, B.Sc.; The Cause and Limit of Organic Growth, by F. T. Mott, F.R.G.S.; A Catalogue of Leicestershire Land and Fresh Water Mollusca, by H. E. Quilter, M.C.S.; The Poetic Drama of the present Reign, by the President, A. H. Paget with a few more literary papers.

The Birmingham Philosophical Society, in its published Proceedings, states that the Endowment of Research Fund, which it had the honour of initiating, still continues to be useful for the purpose for which it was instituted. Grants have been made in aid of researches on the Hardness of Metals, the Erratic Blocks round Codsall, and the Study of the Bacteria, as well as general chemical research by Dr. Gore. Reports on these matters have been presented to the Society, and have proved the value of the assistance which the fund has rendered.

Among the important papers contained in the last published volume of Proceedings may be mentioned:—Professor Windle on the Myology of Hapale Jacchus; Thomas Turner, F.C.S., on the Hardness of Metals, and on Silicon in Iron and Steel; Professor J. H. Poynting on the Electric Current; Professor Poynting and E. F. J. Love on the Law of the Propagation of Light. Dr. Gore on the Electrolysis of Alcoholic and Ethereal Solutions of Metallic Salts, on the Effect of Heat on Fluoride of Cerium, and on Transfer Resistance.

An important step has also been taken by this Society in the formation of special sections for the study of the various branches of Natural History. Not much more than a beginning has yet been made in this direction, but the rule which has been adopted by which persons not members of the Society can become members of the section, on payment of a quite small fee, is calculated to make the sections available as centres round which may gather the special workers in the various subjects in a manner scarcely possible for the more miscellaneous general Societies.

The Journal of the Northamptonshire Natural History Society and Field Club contains many important papers on Natural History. Among them a part of the Flora of Northamptonshire, by G. C. Druce, F.L.S.; Notes on the Birds of Northamptonshire, by Lord Lilford, F.L.S.; Notes on the Polyzoa, &c., from the Gayton Boring, by G. R. Vine; a Deep Boring at Bletchley, by H. J. Eunson, F.G.S.; Northamptonshire Mosses, by H. N. Dixon, F.L.S.; Notes on the Migrations of Birds, by Rev. H. H. Slater, F.Z.S.; Pre-historic Man in Northamptonshire, by T. J. George, F.G.S.; Meteorological Notes, by H. Terry.

This Society has also a photographic section, and the Journal is illustrated with occasional photographs—such as one of a monumental bust of Wm. Smith, the father of English geology, and of the peculiar tower of Irthlingborough Church.

The work of the more specially Field Clubs in the Union, although not so capable of report, seems to have been well maintained during the past year. At many of the Field Meetings papers illustrative of some of the special features to be observed are read, and the parties have the advantage of the ready help of the more experienced members as well as, frequently, of that of the naturalists of the district visited.

We think it is evident, from the account given above of the work which is being done by our Societies, that there is a good deal of scientific energy which the Union ought to be able to make more generally useful. We have a certain amount of organization which might be made the means of much more communication among the Societies than is at present maintained. But, of course, in this matter the Union must take its character from the Societies which compose it. If the desire for interchange of papers, &c., is felt, the way to carry out the plan will be easy; on the other hand, if there is no desire for such interchange, the Union cannot hope for any success in the attempt.

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.*

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

The first aim of a local Society like ours should be to make a careful and accurate record of all the natural phenomena of our neighbourhood; but, were we content with this alone, we should scarcely be entitled to consider ourselves a *scientific* body. Science does not consist in the mere accumulation of facts, for no matter how interesting these may be in themselves, we must remember that after all they are only a means to an end. Facts *belong* to science, it is true, but we must look upon them merely as the raw material out of which we elaborate, by processes of scientific reasoning, great principles of universal application.

I sometimes hear it asked whether the lists of the district fauna and flora, which are so carefully compiled by many hard working members of our local societies, have any value, apart from that of an index to the student of the exact locality where he may expect to find any particular plant or insect which he may be studying. Now, undoubtedly, the immediate value of such lists is the one I have indicated,

* Delivered November 4th, 1887.

but they have a far greater importance than this in affording material to the philosophical naturalist for studying geographical distribution, and for working out all those great influences of climate, soil, and general external conditions, upon the varietal changes which occasionally become stereotyped as new species. In order to facilitate this highest aim of the naturalist our local societies ought, I think, to make their lists more *quantitative* in character, if that is possible, and to note more than they do at present the inter-dependence of animal and vegetable life, and the relations of the plants to the geological nature of the soil upon which they are found. The field geologist often gets valuable hints as to the character of the rocks hidden under a thick mantle of vegetation by observing the nature of the plants growing upon them. Plenty of instances of this kind must occur to any geologist who has occupied himself with the minute survey of a district. As a good example, I may mention that Professor A. H. Green, during his survey of the Carboniferous Rocks of North Derbyshire, found that he was often able to define the boundary of the Carboniferous Shales and Sandstones by the fact that rushes are found on the shales, and that heath and furze grow more plentifully on the sandstones; and he also notes that a crowded belt of the little *Viola lutea* is often seen along the outcrop of a sandstone bed, whilst not a single plant will be found on the shales that come out on either side.

The aid which botany is able to afford to geology is manifestly reciprocal, and if botanists would only take care to note, amongst other things, the kind of sub-soil upon which any particular plant grows, they would, I think, render their lists more valuable and attach to them a far wider interest than they commonly possess.

These are mere suggestions which I venture to make for your consideration, but I will not enlarge upon them this evening, as I wish to occupy your time in trying to deduce from a mass of geological facts, which to many of you must seem dry and uninteresting, certain generalisations which, I trust, will prove of interest even to those who have no special knowledge of geology.

The student of geology, whilst occupied in observing the thickness of strata, their physical nature, order of superposition, angles of dip, and fossil contents, finds, it is true, a keen and vivid enjoyment in such work, but if he is of a philosophical turn of mind he will place but little scientific value upon such observations when they are regarded as mere isolated phenomena; but when a large mass of facts has

been accumulated and systematized, it becomes possible, by a comparison and correlation of results, and by the application of strict methods of reasoning, to make out the order of past events, and to read by the light of the present the physical changes which this world of ours has undergone in ages long past. This is, indeed, the highest aim of geology, which has been well defined as the "physical geography of the past," and, I think, I shall do well by attempting to show you something of the methods by which this reconstruction of old-world features is accomplished, and by applying them to the elucidation of some of the past conditions of the portion of central England in which we live. The period which I have selected for this purpose is that in which were laid down the great mass of the Carboniferous Rocks—rocks including the Mountain Limestone and the Coal Measures. Owing to their vast superficial exposure in Great Britain and Ireland, and to the manner in which they have been explored for their mineral wealth, we have, perhaps, in the Carboniferous Rocks, a greater accumulation of important facts to work upon than we have in any other system.

Before attempting to throw any light upon this chapter in the ancient physiography of our Midland district, I must, in the first place, call your attention to the existing conformation of the surface, and to the close connection there is between the nature of the underground rocks and the features of the country as now presented to us.

If we look at any good physical map of England we notice, running almost down the centre of the Northern part of the country, a broad range of hills, which forms a great water-parting, from the western side of which the streams run into the Irish Sea, and from the eastern into the North Sea. This broad ridge of high ground, one of the most striking natural features of our country, is known as the Pennine Range, and has been aptly described as the *backbone* of England. It attains its highest elevation of about 2,600 feet in the North Riding of Yorkshire, and in the Peak, the highest part of North Derbyshire, it reaches about 2,000 feet above the sea level. When followed from the northern counties southward this ridge of high land is found to terminate abruptly a few miles to the west of Ashbourne, in the Weaver Hills, and it is this southern portion of the range which serves to illustrate in the best possible way the geological structure of the Pennine Chain.

The rocks constituting the Chain belong exclusively to the Carboniferous System, that great division of the older rocks which, in its upper part, contains all the principal coal seams

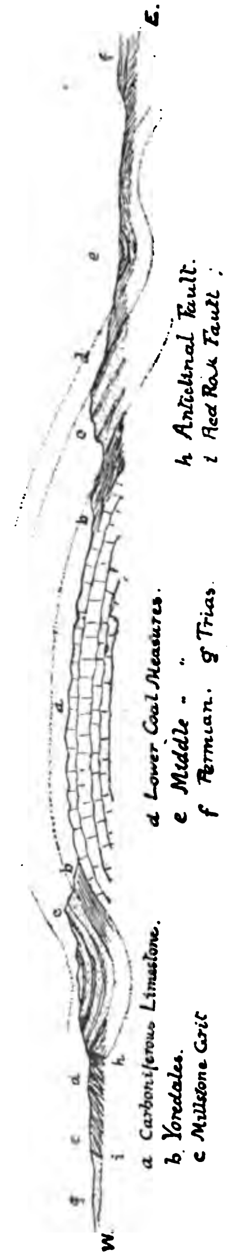
of this country. This division, or *system*, as geologists call it, can be broadly divided into four series of strata which are invariably found in the same vertical order or succession. The lowest series is that of the *Mountain Limestone*, a mass of hard, and in some cases almost crystalline, Limestone rock. Above the Mountain Limestone we have a series of black shales and sandstones, with thin beds of impure limestone, known as the *Yoredale Shales*: and above the Yoredale Shales we have the *Millstone Grit*, a mass of coarse sandstones with thick shale partings, and an occasional thin seam of impure coal. The Millstone Grit is in turn overlaid by the Upper, Middle, and Lower Coal Measures, which are made up of an assemblage of sandstones and shales, with many important and excellent beds of workable coal in their middle division.

Upper Carboniferous	Coal Measures	Upper.
		Middle.
		Lower.
	Millstone Grit.	
Lower Carboniferous	Yoredale Shales.	
	Mountain Limestone.	

The exact line drawn between these various members of the Carboniferous System is, for the most part, an arbitrary one, for although, when looked at as a whole, each division has very different characters from the one below and above it, yet they often pass into each other vertically by insensible gradations.

The total thickness of this great pile of strata is probably over 12,000 feet in Derbyshire, and this does not represent the whole of the original thickness of the beds. From the evidently *sedimentary* character of all these rocks we are quite sure that the materials were laid down under water in a horizontal, or almost horizontal, position, but we now find them elevated considerably above the level of the sea, and with their original bedding lines inclined to the horizon at all sorts of angles. The true relation of such beds to each other, and to the present conformation of the surface, can only be ascertained when a large district has been surveyed, and all the outcrops of the strata laid down on a map with the observed inclinations or *dip* of the strata, as it is called. From such maps it is possible to construct imaginary sections across a country, showing at a glance the present position of strata, which, once forming horizontal and continuous sheets, may now have become folded, faulted, and disconnected in all sorts of complicated ways.

You have before you such a horizontal section, taken along an east and west line across the Pennine Range, from


W.
E.
a Carboniferous Limestone.
b Yoredales.
c Millstone Grit
d Lower Coal Measures.
e Middle " "
f Permian.
g Trias
h Anticlinal Fault.
i Red Rock Fault;

about eight miles north-east of Chesterfield, through Buxton to Macclesfield, a total distance of about thirty-five miles. This section must be considered as diagrammatic, for besides having its vertical scale much exaggerated, it has been somewhat generalised so as to bring into prominence the salient points bearing upon the structure of the Range.

You will observe that the rocks, which, as I have said before, were originally laid down in a horizontal position, are now thrown into a huge *fold* or *arch*, with one or two minor folds or corrugations flanking it.

The direction of the folding is approximately north and south, and looked at in a general way the strata incline from the centre of the arch both to the east and to the west, just as the slanting sides of a roof do from the ridge tile. As we travel from the central mass of limestone of North Derbyshire in either of these directions we pass successively, and in ascending order, over the edges of all the divisions of the Carboniferous System right up to the Coal Measures. A study of the map and section would strongly suggest to us that the strata which are now thus severed were once continuous right across the arch, and this is put beyond doubt, not only by the similarity of the sedimentary strata on either side, but also by the proved identity, a little further north, of several of the Coal Seams in the Lancashire and South Yorkshire Coalfields, which lie on opposite sides of the great fold. The crown of the arch or *anticlinal* has, in the district we are considering, been so far destroyed since its elevation, by the ceaseless action of rain and river, frost and snow, aided to some extent by the sea, that the great mass of Coal Measures, Millstone Grit, and Yoredales, which once stretched right across from side to side, has been completely swept away, exposing to the light of day the Mountain Limestone; so that this, the lowest member of the Carboniferous Series, now occupies the most elevated part of the ridge.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

EDWIN LEES IN HAST. "ILL. NAT. HIS. WORC., *continued*."

(Continued from page 185.)

* **Hyoscyamus niger**, 156. Side of the road beyond Spetchley, but most abundantly near Little Malvern, at the base of the Herefordshire Beacon. *The last named locality is possibly in Herefordshire.* L.M.

* **Verbascum Thapsus**, 156. Abundant about the Malvern Hills, and by the road sides in neglected spots. L.M.

* **V. Lychnitis**, 156. Near Malvern.

* **V. virgatum**, 156. Formerly found by the side of the Kidderminster Road at Bevere, near Worcester, where it was first noticed by Dr. Stokes. It has been gathered in the same habitat so late as 1829, but has now disappeared. S.G.

* **V. Blattaria**, 156. In the vicinity of Malvern. S.G. L.M.

* **Digitalis purpurea**, 169. In immense quantities about the Malvern and Abberley Hills, and scattered in various other places. L.M.

* **Antirrhinum majus**, 169. Walls about the Commandery, Cathedral, and Bishop's Palace. S.G. L.M.

* **A. Orontium**, 169. Cotheridge. Mr. Walcot. Kempsey. Dr. Streeten.

* **A.** (*Linaria*) **Cymbalaria**, 169. On the old city walls, Worcester; and the south side of the Abbey Church, Great Malvern; but a garden straggler. S.G.

* **Veronica montana**, 149. Described by Purton as "very rare." Wood at the west end of Powick Ham, near Worcester; Dr. Stokes; where it has since been found by Dr. Streeten, but Mr. France having recently built upon this spot, and made alterations in the ground, the plant has disappeared. In a wood nearer to Malvern. Mr. Lees. By the side of a stream in a place called "the Gullet," between the Swinnet and Hollybush Hills, in the Malvern Range, southward of Little Malvern. Messrs. Morris and Lees, 1834. *The Gullet is about 1 mile south of the Herefordshire Beacon, and the locality probably in Herefordshire.* S.G. *V. montana is not uncommon about Malvern and in the upland woods in the northern part of the county of Worcester.*

* **V. scutellata**, 149. Bogs on the Malvern Hills, especially at the western base of the Worcestershire Beacon. Rare. S.G.

* **V. Anagallis**, 149. Pools near Powick on the Malvern Road. Ashmore Common. Near Pershore. Duck Brook, near Worcester. S.G.

* **Pedicularis palustris**, 169. Rather uncommon. In the boggy marsh at Wyre, near Pershore.

* **Lathræa squamaria**, 169. Growing in some abundance under a white poplar tree by the side of the brook below Bridgestone Mill, Alfrick. Mr. Lees. Also above the bridge, near the Mill. At Great Malvern, under an elm by the side of the road near the turnpike. Mr. Addison. S.G. L.M.

* **Orobanche major**, 169. In Shrawley Wood, by the pool; at Abberley, on the acclivity above the Hundred House; and between Suckley and Bear's Wood.

* **Verbena officinalis**, 168. Near Farm Houses at Barnard's Green, Powick, &c.

Mentha sylvestris, 168. By the side of a rill beyond the yew tree on the Ombersley Road, Worcester.

* **M. piperita**, 168. By the side of a rill at Malvern Link, and in other wet spots about the Malvern Range. L.M.

M. rubra, 168. By a pool near the firs, at Clifton-on-Teme.

Origanum vulgare, 168. Side of the road at the foot of Craycombe Hill, near Evesham. Also at the top of Southstone's Rock, and at Lower Sapey. Mr. Lees.

* **Thymus Calamintha** (*C. menthifolia*), 168. About Malvern, Grimley, &c., by road sides. L.M.

* **Nepeta Cataria**, 168. Lane beyond the Gas Works, Worcester, and in other similar situations. L.M.

* **Salvia Verbenaca**, 150. On the bank by the road side. at Red Hill, near Worcester. S.G.

* **Scutellaria galericulata**, 168. In marshy spots by the side of the Severn. Kempsey Brook.

* **Marrubium vulgare**, 168. At Astley, and Clifton-on-Teme.

Lamium maculatum, 168. Found near Defford Common, by Dr. Streeten.

* **Galeobdolon luteum**, 168. In Berwick's Shrubberies, and various shady woods at Powick, Kempsey, Alfrick, Clifton, &c.

* **Echium vulgare**, 154. Not uncommon in the northern part of the county, but almost unknown in the southern. On the walls of Dudley Castle.

* **Lithospermum officinale**, 154. Battenhall, near Worcester, and on the lime rubbish about the western base of the Malvern Hills. S.G. L.M.

* **Myosotis cæspitosa**, 153. Ditch in the Severn Meadows, Kempsey. Dr. Streeten. L.M.

M. arvensis, 153. Sandy bank between Hagley and Stourport.

* **M. versicolor**, 153. On the summit of the North Hill, Malvern. Ankerdine Hill.

* **Borago officinalis**, 154. Battenhall, near Worcester, and about Bromwich Farm. At Lower Wick. S.G.

* **Anchusa sempervirens**, 154. Under an old elm tree beyond the old Waterworks. Very uncommon. S.G.

‡* **Cynoglossum sylvaticum**, 154. In Deerhurst Lane, close to the Lower Lode Ferry near Tewkesbury. Very rare. *This habitat is in Gloucester.* S.G. L.M.

* **Pinguicula vulgaris**, 150. On the north-west side of the Malvern Hills, in the bog below the Worcestershire Beacon, but in no other part of the range. L.M.

* **Hottonia palustris**, 155. Pool at Clifton-upon-Severn. Dr. Streeten. S.G.

* **Primula elatior**, 154. Oxlip. About Leigh Sinton, Cradley, &c., in pastures on limestone. S.G. *This is not the true P. elatior, Jacq, but P. vulgaris, var. caulescens.*

* **P. veris**, var., 154. "Black Cowslip" of Dr. Abbot. A singular dark flowered variety found in a field at Bromwich Farm, by Mr. Lees. S.G.

* **Lysimachia vulgaris**, 155. By the side of the weir above Powick Bridge, and banks of the Teme above Bransford. Banks of the Severn below Pixham Ferry. Very rare in this county. S.G.

* **Anagallis cærulea**, 155. Plentiful in a fallow field near the Trench Woods. Mr. Edmunds. A singular pale purple variety, found at Shrawley by Messrs. Walcot and Lees.

* **A. tenella**, 155. Bogs on the Malvern Hills. L.M.

* **Samolus Valerandi**, 156. In the rills at Battenhall, near Worcester, and on Defford Common.

* **Plantago Coronopus**, 153. On the conglomerate rock near the Giant's Grave, Habberley, near Kidderminster. Mr. Lees.

* **Rumex palustris**, 161. Side of the Chalybeate Spa at Malvern. L.M.

* **Polygonum Bistorta**, 161. Meadow near the Spa, at Malvern. Mr. Edmunds. Also by the rill at Southstone's Rock; in a meadow at the top of Trimpley Green, near Kidderminster, and in a moist pasture at Wichenford. S.G. L.M.

† **P. viviparum**, 162. On Rosebury conglomerate rock by the Teme, below Knightsford Bridge. Mr. Lees. L.M. *An error; see New Botanists' Guide, p. 203.*

* **Daphne Mezereum**, 161. Eastham and Stanford. Rev. E. Whitehead.

* **Aristolochia Clematitis**, 177. Springing up in great abundance at the back of the garden of the large house in Foregate Street, lately occupied by Mrs. Pennethorne, pulled down to make room for the new Courts, 1834.

Euphorbia Lathyris, 177. Crow's Nest Woods. Dr. Streeten.

* **Parietaria officinalis**, 153. Old walls near the Cathedral. S.G.

* { **Ulmus campestris**, 157. In almost every hedge.
U. suberosa, 157. Hedges near Hallow.
U. glabra, 157. At Hindlip. }

* **U. montana**, 157. About the base of the Malvern Hills, &c.

Fagus Castanea (*Castanea vulgaris*), 178. In Shrawley Wood, apparently wild.

* **Populus alba**, 178. At Alfrick, and in the vicinity of several brooks.

* **P. tremula**, 178. Nunnery Wood, Malvern, Clifton-on-Teme, &c., not very uncommon.

* **Juniperus communis**, 178. Bear's Wood, Suckley. Cracombe Hill, &c. L.M. *Bear's Wood is in Herefordshire.*

Typha angustifolia, 177. In a small pond on the Moors, Worcester, and in the pool at Ham Castle. Mr. Lees.

† **Sparganium natans**, 177. Muddy pools near Cotheridge. Mr. Walcot.

Sparganium minimum, Fr., is intended here, and is a true record, see "Botany of Worcestershire," p. 56, and Watson's "Top. Bot.," 2nd Ed., p. 428.

* **Acorus Calamus**, 160. In the Avon near Pershore, but rare.

Potamogeton natans, 153. Pool at Wichenford, and ponds about Malvern.

P. pusillus, 153. Kempsey Ford.

P. pectinatus, 153. In a pond near the old Waterworks, Worcester.

* **Triglochin palustre**, 161. Marshy spots about the Malvern Hills. L.M.

* **Sagittaria sagittifolia**, 178. In the Avon, and its tributary streams.

* **Butomus umbellatus**, 162. River Severn, below Kempsey Ford. Dr. Streeten. Abundant by the banks of the Avon, but rare near Worcester. It has, however, recently stolen into the Birmingham Canal. S.G.

Hydrocharis Morsus-ranæ, 178. In a pool by the side of the New Road, Worcester. Also in several other ponds near Powick and Kempsey.

* **Orchis pyramidalis**, 175. On the edge of the wood near the Lime Kilns at the Croft Farm, Mathon; and abundantly in the meadows by the Spout Brook, at Eastham. Mr. Lees. L.M.

* **O.** (*Gymnadenia*) **conopsea**, 176. Abundantly in the meadows at the northern end of the Malvern Range. L.M.

* **O.** (*Habenaria*) **viridis**, 176. On Hill Top, Cotheridge. Mr. Walcot. Meadow near Cowleigh Park, Malvern (*Hereford*). In a wet meadow at the northern base of the Round Hill, Abberley, plentifully. Messrs. Lees and Edmunds. L.M.

* **O.** (*Habenaria*) **bifolia**, 175. In various hilly woods at Powick, Abberley, Malvern, &c., but not in any great abundance. *Habenaria chlorantha, Bab., is the plant probably intended here.* L.M.

* **Ophrys apifera**, 176. In great abundance at Leigh Sinton. In almost equal abundance on the travertine by the Spout Brook at Eastham. Mr. Lees. S.G. L.M.

* **Neottia spiralis** (*Spiranthes autumnalis*), 176. In Kempsey Grove. Dr. Streeten. On the Common near Hunter's Hall, Little Malvern, and on the mound of Crookbarrow, near Worcester. Mr. Lees. S.G. L.M.

Listera (*Neottia*) **Nidus Avis**, 176. In a coppice at Kempsey. Dr. Streeten.

Epipactis latifolia. In a place called the Dingle (*Ham Dingle*), at Pedmore, near Stourbridge, and in the deep shades of the Devil's Den, at Clifton-on-Teme. Mr. Lees.

* **E.** (*Cephalanthera*) **ensifolia**, 177. On the top of Abberley Hill. Rev. T. Butt. In the deep retired glades of Bewdley Forest, between Mopson's Cross and the Sorb Tree. Messrs. Walcot and Lees. S.G.

ON THE SUCCESSFUL USE OF OIL TO CALM ROUGH SEAS.

BY W. P. MARSHALL, M.I.C.E.

(Concluded from page 174.)

The oil shells that have been used contain about three quarters of a gallon of oil, and they are fired from a mortar with a charge of eight ounces of pebble powder. The shell is simply an oil-flask, at the bottom of which is a recess for a special fuse, which consists of two small chambers, in which there is a projecting submarine fuse about an inch in length. The fuse is capped with a composition that renders it absolutely water-proof, and is so constructed as to secure its

ignition with unfailing certainty; and the fuse is timed so that it bursts at the point required, just as the shell is touching the surface of the water; the oil from each shell covers a very considerable area of surface. In a trial at Folkestone on 29th January, 1884, of these shells, which are the invention of Mr. Gordon of Dundee, about a dozen of them were fired at a range of from 450 to 500 yards. The effect was wonderful; the raging waters were gradually allayed, and for a considerable space the sea was converted into a lake with a gentle swell, in which a ship or a boat could ride with perfect ease. The smallest seaport may, therefore, with an old mortar and a dozen or two of gallons of oil, make a temporary harbour of refuge whenever the necessity arises.

Another plan for protecting harbours in storms, that has been devised by Mr. John Shields, of Perth, is a submerged pipe, carried out several hundred feet from the pier, into which oil is pumped; a lead pipe about 1¼ inch bore is used, and at distances of a hundred feet apart are fixed upright pipes eighteen inches high, in each of which is a conical valve opening outwards and protected from silt by a rose. In a trial of this plan at Folkestone harbour, a lifeboat was rowed out of the harbour, and lying off the pierhead, rolled a good deal, but did not get a splash while in the wide glassy strip of oil-covered waters that soon stretched away for half a mile or more, though to seaward of this glistening streak the waves were curling and breaking into foam. On the harbour-side the effects of the oil were noticeable far in-shore, and few white caps were to be seen; the film, greatly attenuated as it must have been, and not more than 100 feet wide, acting apparently as an efficient breakwater.

The distance to which the protecting effect of the oil extends, and the efficiency of this protection at sea, is illustrated by the following case. A large trading steamer plying from New Orleans, encountered a terrible hurricane in the Caribbean Sea, in October, 1887, when the ship was disabled and became unmanageable, and lay in the trough of the sea in a dangerous position, and entirely at the mercy of the waves, which repeatedly broke over her. The captain, finding it impossible to keep the ship's head up, determined to have recourse to the oil experiment. He put four oil-bags on the windward side of the ship, when the oil acted like magic. The sea became smooth for at least twenty-five yards in that direction, and not a sea broke over her, while ahead and astern and to leeward the ocean was in a wild rage. Here was an extraordinary escape from immediate danger; the remedy was continued, and the ship lay for thirty hours in the trough of

the sea, free from the danger of broken water, and protected by the application of the oil, until, at the end of that time, the hurricane passed away, and the ship was enabled to proceed on her voyage uninjured. It is not too much to say that had it not been for the efficacy of the oil, the ship, in her helpless condition, must have succumbed to the violence of the hurricane, and probably all on board would have perished.

The great danger of the sea is not from the height to which the waves sometimes rise; waves are not dangerous from their height, unless they break at the top. On the day after a storm, when the wind has fallen, a tremendous swell will often be seen, the waves rising to a considerable height; but no danger is to be apprehended from waves of this kind, however unpleasant they may be to non-seafaring passengers. It is when the winds howl, and the white sea-horses are seen raising their snowy crests, that the sailor knows danger to be at hand. Should any one of those black walls of water crowned with white, crash on to the deck of the ship, the results would be terrible. The oil cast upon the waves does not cause them to go down, and form a calm spot amongst the turmoil; it merely, in certain cases, prevents the waves from breaking, and turns a raging sea into a heavy swell.

It is only in certain cases that ships can be brought into the water which has been treated with oil; if a ship is sailing or steaming with the wind on her beam, at right angles to the course on which she is steered, the oil cannot be so distributed as to lie on the water through which she is going. But should the vessel be in great danger from the waves which are breaking around her, the following plan can be pursued. The vessel should be hove to, that is, steered nearly into the wind's eye, and kept as stationary as possible; she will then drift slowly to leeward, that is, in the same direction as the wind. One or more oil-bags attached to light lines should be put overboard to windward, and the result will be that the vessel, being more exposed to the wind, will drift more rapidly than the bags, which will be left some distance to windward, and thus intercept and mollify waves which would otherwise come leaping and foaming towards the ship.

As, to be any protection, the oil must be distributed over the sea in the direct line from which the seas are advancing, and at a sufficient distance to give it time to spread and act upon the waves before they reach the vessel to be protected, it follows that, as regards any small boat, the oil can only be used when it is in one of two positions, namely, when anchored and lying head to sea and tide, or when running dead before the sea for the shore. In the first case the waves would

approach the bows of the boat, over which oil should be poured, or, better still, a bag of oil floated some yards in front of the boat, attached by a light line to the anchor so that the oil may spread all round. In the second case, when the boat is running with the wind and waves, the danger would be lest a wave should follow on so quickly as to break over the stern of the boat and overwhelm her. Oil poured over the stern of the boat will, to a certain extent, quiet these following waves, and prevent such a risk. It has to be noted that the calming effect of the oil is greatest in deep water, and the results are more marked and beneficial at sea than in surf or breakers, where it is shallow water. In surf, or waves breaking on a bar in shallow water, the effect of oil is uncertain, as nothing can prevent the larger waves breaking under such circumstances, but even here oil is of some service.

An official report upon the use of oil at sea for modifying the effect of breaking waves, is given in a memorandum from the Admiralty, of 16th June, 1886, giving a report by Captain Chetwynd, of 30th September, 1884, to the National Lifeboat Institution upon this subject, with directions for the application of the oil. Admiral Cloué, of the French Navy, gave to the Academy of Sciences, 6th June, 1887, the results of more than 200 experiments that had been made upon the subject, mainly in England and America, and he concludes that there can no longer be any doubt that oil has a most efficacious result in calming storm-tossed waters, and thus saving vessels in danger of foundering at sea. He says fish oils appear the best for the purpose, mineral oils owing to their lightness are less effective.

The United States Hydrographic Office, in calling attention to the subject in 1887, states that there is now ample evidence that the use of oil is of considerable service in lessening the effect of dangerous seas. It is noticed that the "slick" made by the oil has extended as far as thirty feet to windward, and it is concluded that the oil is of use when a vessel is reaching ahead at a speed of eight or nine knots an hour, with a beam wind and sea.

Much of the action of the oil seems to be simply as a direct lubrication between the surface of the water and the air, reducing the friction between them. This friction is very considerable ordinarily, and much greater than at first appears possible; and it is shown by the heavy scud seen flying in a gale at sea, which is water lifted up and carried a long distance by the friction of the air passing over the surface of the sea. The crests of waves are torn off and carried away by violent gusts of wind; and a great source of danger in a

storm is a mass of water that has been thus lifted into the air crashing down upon the deck and swamping a vessel. The extreme case of friction between the air and the water is a waterspout, in which a great mass of water is lifted up bodily high into the air, and held suspended there by mere friction between the air and the water. This remarkable friction only shows in storms and hurricanes, where the air is moving at a very high velocity whilst the water is stationary, causing an enormous number of particles of air to come in contact with each single particle of the water; and, though the moving effect of each single particle of air can be only extremely minute, the total accumulated effect becomes enormous. The action of the oil as a lubricant upon the surface of the water is so efficient, that the air sweeping over it at a high velocity is unable to catch hold of the surface and lift the water, and an exceedingly thin film of oil, a mere scum, is found sufficient for this purpose. The small quantity of oil that is consequently required, the simplicity of the means of application, and the great success and value of the results that have been obtained, render this plan well worthy of general adoption.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Continued from page 170.)

The Herbarium and Library.

The main object of the Herbarium and Library is to furnish the means of identifying the living plants indicated in the Garden, the dried plants that are sent home from India and the Colonies, or are collected by British explorers in other parts of the world, and the economic specimens that are sent to the Museum. The Herbarium is kept in the large brick house, fenced round with tall iron railings, which stands at the north-west corner of Kew Green, which was formerly occupied by Ernest, Duke of Cumberland, the fourth son of George III., and afterwards King of Hanover. Ten years ago a three-storeyed room, 80 feet long, was built for the express purpose of accommodating the cabinets of dried plants. It is open from floor to roof, and has two galleries, reached by spiral staircases of iron. Between each row of cabinets there is a window and a table, so that there is plenty of light, and

the plants in the cabinets do not need to be carried far when they have to be consulted. The most important part of the collection is the set of Indian and Colonial plants. Here are deposited the types from which the descriptions in the Indian and Colonial floras were made, and the whole collection is so arranged that, of almost any of the 46,000 plants that grow on British soil, a specimen duly named and authenticated can be referred to in a few minutes. Besides these the Herbarium contains a large collection of plants from other parts of the world.

At the death of Sir William Hooker it was estimated to contain one million specimens, counting as one all individuals of the same plant from the same locality. At present about twenty thousand specimens are added every year. When dried collections are examined, the rule is that in recompense for the trouble of naming them the Herbarium is allowed to keep whatever is required, and it is to a large extent in this way that its growth goes on. At present, for instance, Dr. Aitchison, the naturalist attached to the Afghan Boundary Commission, is engaged in working out the identification of the eight hundred species he has collected. During the last ten years the missionaries in Madagascar have sent home 5,000 numbered specimens, and of these the determinations have been sent out to them. and the new species of which there was enough material, 700 or 800 in number, have been described and named.

For any little-known country like Madagascar the plants that grow wild there are one of the best tests of its climate, and furnish a guide to the useful plants that may be cultivated with a fair chance of success.. The foundation of the Kew Herbarium was the private collection which Sir William Hooker brought with him from Glasgow in 1840, and to this was added the herbarium of Mr. Bentham, and a set of the specimens collected in the Antarctic and Indian travels of Sir J. D. Hooker. Of late years the principal special additions have been the European herbaria of Gay and John Stuart Mill, the orchids of Lindley, the British herbaria of Watson and Borrer, the mosses of Bruch, Schimper, and Hunt, the lichens of Leighton, the algæ of Mrs. Griffiths, and the fungi of Berkeley and Cooke. Besides the Indian and Colonial floras, Mr. Bentham and Sir J. D. Hooker have elaborated a " Genera Plantarum," in which the ten thousand genera of flowering plants are fully described and classified under their natural orders. This was the work of twenty years, and it is used in the Garden, Herbarium, and Museums as the standard of nomenclature and classification.

Two periodicals are published in connection with Kew, the "Botanical Magazine," in which six new or interesting plants fit for garden cultivation are figured every month. This is now in its 112th volume, and contains nearly 7,000 coloured figures, all drawn from living plants. In the "Icones Plantarum," of which the seventeenth century is now in progress, the more interesting new plants that come to Kew in the form of dried specimens are figured and described. In the same buildings as the dried plants there is as full a collection of all the books and pamphlets on botany as the authorities have been able to get together. The number of volumes is about ten thousand. This occupies four of the rooms of the old palace. There is also a large collection of drawings, arranged in portfolios in systematic order. For naming living plants from the Garden these drawings are very much used, for of course they show the colouring of flowers far better than the dried specimens possibly can.

Museums of Economic Botany.

There are three Museums in which are stored the collections of timbers and economic products. The principal Museum is the large three-storeyed building which stands in the centre of the Garden on the opposite side of the sheet of ornamental water to the Palm House. This is devoted to the products of the 150 natural orders of Dicotyledons, arranged in glass cases in systematic order. A similar collection of the products of the Monocotyledons and Cryptogamic natural orders is contained in a smaller museum, which stands at the north end of the Herbaceous Ground. In the old Orangery, not far from the main gate and the palace, are the large specimens of timber. Many of the specimens in these museums are derived from the great Exhibitions of 1851 and 1862, and from the India Museum. In addition to timbers, textile fabrics, food grains, medicines, and models of edible fruits, these museums contain the specimens of fruits and seeds which are too large to be mounted on the sheets of paper at the Hebarium.

Value of Vegetable Products.

Just consider for awhile what a large proportion of the food and clothing of mankind has to be derived from the Vegetable Kingdom. Last year the value of the agricultural crops grown in Great Britain alone amounted to £136,000,000. The value of the grain and flour imported amounted to £67,000,000. These two added together amount to over £200,000 000, or an average of £6 per head for each person

in the country. The exports of the United States, mainly grain and cotton, amounted last year to 750,000,000 dollars, or nearly £150,000,000. The total exports and imports of India last year amounted to £131,000,000, and of this materially over £100,000,000 belonged directly to the Vegetable Kingdom in one form or another.

The Future of the Anglo-Saxon Race.

Consider, also, to what a large extent the future fortunes of the British Empire depend upon a proper development of the capabilities of our Colonial possessions to produce the vegetable crops that are useful to the human race for food, clothing, medicine, and other economic uses. Our population is now 350 millions; what will it be in a hundred years time? Notwithstanding emigration, the population of Great Britain has doubled in the last half-century, whilst that of France, which in the seventeenth century amounted to 38 per cent. of the whole population of Europe, now hardly attains 13 per cent. To 350 millions add fifty millions for the population of the United States, which has increased above 20 per cent. during the last ten years. The estimate recently put forward by Mr. Gladstone does not seem at all an extravagant one, that in a hundred years' time it is not improbable that the English-speaking race and its subjects will amount up to a population of 1,000 millions. How all these men and women and children are to be supplied with needful food and clothing is a problem that will try to the very uttermost the knowledge and the foresight, and the energy and the enterprise, of the generations that are to follow our own.

(To be continued.)

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical Section, June 6th. Mr. J. F. Goode read a paper entitled, "Notes on some Foraminifera, collected and mounted by Mr. E. W. Burgess, from Material obtained near Oban by the Society, during their dredging excursion in 1883," illustrated by specimens in microscopes and by a fine series of micro-photographs by J. Edmonds, exhibited in the oxy-hydrogen lantern, by Mr. C. Pumphrey. Mr. Pumphrey afterwards gave by the same lantern an interesting exhibition of fine photographs of flowers and other objects.—Microscopical Section, July 3rd, Mr. W. B. Grove, B.A., exhibited *Peziza clavus* and *P. ebuli* (new to the district), *Ascobolus immersus* and *Sordaria discospora* from Clent Hills; and also (for Miss Gingell) *Ag. gambosus*, *Ag. carneus*, and *Peziza acetabulum* from Dursley.

Mr. W. H. Wilkinson exhibited an abnormal gooseberry from Handsworth, being developed on one side only, giving a curved appearance to the fruit. As three trees were affected in a similar manner, it may have been caused by the severe weather injuring the upper side. He also exhibited *Meconopsis cambrica*, *Orchis conopsea*, *O. incarnata*, *Claytonia sibirica*, *Oxytropis uralensis* (very rare), *Aira præcox*, and other interesting plants from the Island of Bute and Scotland.—BIOLOGICAL SECTION, July 10th. Mr. R. W. Chase presiding. Mr. W. R. Hughes, F.L.S., as one of the delegates from Birmingham, gave a full and graphic account of the meeting of the Midland Union of Natural History Societies, held at Northampton the previous week, and of the very excellent conversazione which followed. At the general meeting Earl Spencer presided, and after an excellent opening speech, presented the Darwin Gold Medal, this year awarded in Botany, to Mr. J. E. Bagnall, A.L.S. Mr. W. H. Wilkinson also a delegate, gave an account of the Botanical Excursions, and exhibited some of the plants collected, amongst which were *Epipactis latifolius* and *Habenaria chloroleuca*. Mr. W. B. Grove, B.A., exhibited some of the fungi collected at these excursions:—*Agaricus rubescens*, *Ag. squarrosus*, *Ag. Xanthopus*, &c.; also *Ag. phlebophorus*, from Sutton, new to the district. Miss Germain also gave an account of the Archæological Excursions, and exhibited photographs of some of the more interesting buildings in Northampton. Mr. J. E. Bagnall exhibited *Isothecium migurum*, and other mosses from Bearley and Lapworth; for Mr. J. B. Stone, F.L.S., mosses from the Bernese Oberland, collected during a recent visit, at 6,000 feet above sea level, including *Hypnum Oakesii* and *Bartramia Œderi;* for Mr. S. Walliker, mosses and lichens from the Swiss Alps, collected by Mrs. R. Peyton; for the Rev. D. C. O. Adams, *Habenaria bifolia* and *Senecio campestris*, from Crowell, Oxon; for Miss Gingell, a number of rare Gloucestershire plants, including *Astragalus hypoglottis* and *Habenaria chloroleuca;* and for Mr. R. W. Chase, from his garden at Edgbaston, a peculiar fasciated stem of the holly, in which five or more branches had coalesced so as to form ribbon-like branches, the whole plant being more or less abnormally developed.—SOCIOLOGICAL SECTION. Supplementary meeting, June 7th. Mr. W. R. Hughes, F.L.S., in the chair. A letter from Dr. Hiepe was read, announcing his resignation from the society on account of his leaving the neighbourhood. In consequence of the illness of Miss Dalton, the chapter of Mr. Herbert Spencer's "First Principles" on "The Data of Philosophy" was not taken, but in lieu thereof Mr. W. R. Hughes gave an exposition of a portion of Mr. Spencer's essay on "Progress: its Law and Cause." Fourteen members present.—Supplementary meeting, June 21st. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes communicated the agreeable information that he had called upon Mr. Herbert Spencer, and found him greatly improved in health. It was decided to discontinue the meetings of this section during July and August. Mr. Stone exhibited the skull of an aboriginal Australian, and Professor Allen procured two normal skulls for comparison, and explained the points in which they differed from the Australian. Miss Dalton gave her exposition of the second chapter of the second part of Mr. Herbert Spencer's "First Principles," entitled "The Data of Philosophy." Fourteen members present.—Ordinary meeting, June 26th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. J. J. Bagnall, Bentley Heath, Knowle, proposed by Mr. C. T. Parsons, and seconded by Mr. Edmund Tonks, was elected a member of the society. Mr. J. J. Crisford was proposed as a member by Mr. W. R. Hughes, F.L.S., and seconded by Mr. W. B. Grove, B.A. Mr. Grove exhibited specimens

of *Peziza coronaria*. Mr. Wilkinson exhibited a fine specimen of proliferous daisy, *Bellis prolifera*. having seventeen flowerets. Mr. W. R. Hughes exhibited the English portion of Mr. Herbert Spencer's "Table of Descriptive Sociology." Mr. W. Morley exhibited a number of ferns from the fernery of the late Mr. J. Morley. The President exhibited two larvæ, and read a communication concerning them from Mr. Lloyd Bozwani, of Worcester. Mr. F. J. Cullis, hon. sec. of the section, read the second part of his paper on Dr. John Fiske's "Cosmic Philosophy." Fifteen members present.—Ordinary meeting, Tuesday, July 24th. Mr. W. R. Hughes, F.L.S., in the chair. Mrs. Browett exhibited *Peziza coronaria* from a garden. Mr. Hughes exhibited a species of saw fly, found in imported timber used at Hamstead Colliery. Mr. Stone exhibited specimens of young furze (*Ulex Europeus*), showing the transition from the tripartite leaves that appear immediately above the cotyledons to the characteristic spines. Eight members present.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 18th. Mr. J. Collins gave a report of a visit made on the previous Saturday afternoon by members and friends to Hamstead Park, by the kind permission of George Kynoch, Esq., M.P, when many interesting objects were taken. Mr. J. Madison reported 23 species of slugs and snails. Mr. Hawkes showed a fungus *Pilobolus Kleinii;* Mr. J. Moore, a specimen of *Dytiscus marginalis*, covered with vorticella; Mr. Madison, *Arion ater*, var. *rufa*.—June 25th. Mr. Corbet showed pebbles from the drift, containing parts of *Phacops candatus;* Mr. Sutton, root-galls of oak; Mr. J. W. Neville, the butterfly orchis, *Habenaria bifolia*. Under the microscope: Mr. H. Hawkes, a marine alga, *Calliblepharis ciliata;* Mr. Moore, sections of butcher's broom; Mr. J. W. Neville, leaf of *Deutzia corymbosa*, compared with that of *D. scabra*.—July 2nd. Mr. H. Hawkes exhibited *Æcidium geranii* from Llandudno; Mr. Hopkins, a collection of shells from Hamstead Park; Mr. J. Madison, a specimen of *Helix arbustorum*, var. *albinus*, from near Thorpe.—July 9th. Mr. J. Collins read a paper on "Plant Hairs and their Modifications." The writer said, on careful consideration we should find this subject a most important one, particularly to the microscopist. He should have to refer to hairs of various kinds, including prickles, scales, glands, &c. The first form of hair is of papillose structure. Many hairs are short-lived, and are not found on mature plants. The modifications of hairs for useful purposes are many and interesting, and were described under the following heads:—Root hairs, as the only organs capable of absorbing nutriment; hairs of stem as prickles which soon die, not being found on old stems, and hairs of leaves. They doubtless existed as a protection from extremes of temperature, from drought, from the injurious effects of foreign matter, and from the ravages of animals. The hairs of floral organs were even more beautiful than those just referred to, and were useful in connection with insects' visits. Glandular hairs are very common on flowers, and are a defence to the organs. The paper concluded by referring to the theory of the Rev. G. Henslow on the origin of plant hairs (that as they grow where they are of most use, they are the result of irritation to the parts) as a feasible one, and trusted many present would be stimulated to observe these interesting objects. The paper was illustrated by a series of slides under the microscope.—July 16th. Mr. J. W. Neville exhibited specimens of *Lingula attenuata* and other fossils from the Llandeilo formation. Mr. Corbet, *Ammonites Johnstoni* and other fossils from Wilmcote.

INSULARITY.*

BY THE REV. H. H. SLATER.

This seems, perhaps, at the first glance, rather an odd subject to choose for an address to a gathering of Natural History Societies, but I mean to justify its selection, if I can.

You are aware that foreigners call our British manners and ways of thought and action "insular"—a slightly contemptuous way of hinting that our views and aims are as restricted as our boundaries. It is not for me to determine, nor is this the occasion to consider, how far this epithet is generally applicable—though I think that we shall mostly be inclined to admit its justice to some extent. I have no thought, however, of inflicting upon you a general ethical disquisition upon our national characteristics, but rather I would on the present occasion ask your indulgence while I consider whether we do not, in some degree, lay ourselves open to a charge of narrowness in our scientific aims and interests—whether we are not too easily satisfied in confining our studies within the narrow limits of our own islands, or even within the narrower boundaries of our own county, or even parish—and whether British science as a whole, and our own breadth of view, do not suffer in consequence.

At present we shall have to admit that cosmopolitan scientific study is confined to London. There are, generally speaking, no other journals or publications, except those issued in the metropolis, which do not confine themselves to subjects, at any rate, within our own islands. If you purposed to visit any particular part of Asia, or Africa, for example, and desired to prepare your ideas beforehand as to the geology, or fauna, or flora—or some part of one of these in which you happened to be interested—you would find the back numbers of no provincial journal of much use to you. Or if you chanced to be studying some natural group of animals or plants—and by a natural group I mean a closely related group, wherever the members of it happen to be indigenous—you would be obliged to go up to London to do so, for it would be next to impossible to get the opportunity of examining any number of specimens, or to have access to any considerable amount of literature on your subject anywhere else—for you would in other parts of the country be restricted to British, or even local, species and specimens, and the literature only respecting *them*.

* Address delivered at the Annual Meeting of the Midland Union of Natural History Societies, held at Northampton, July 4th, 1888.

There is a very different state of things in Germany, and more or less, in most European countries nowadays. And America is undoubtedly far in advance of Europe in this respect. I feel that we provincials have much to learn from this point of view, which, if learnt, would make our local collections of far greater value than they are at present, and our local journals of more than what they are now, of merely ephemeral interest. From the working zoologist's or botanist's point of view, they are both of them at present—generally speaking—what the French would call a negligable quantity.

It would be all very well if we could only suppose that Great Britain formed anything approaching to a natural zoological or botanical region. But we cannot pretend to maintain this view. As far as zoology is concerned—with which I am more conversant, and to which you will kindly take my remarks as principally referring—Great Britain cannot be looked upon as forming even the semblance of a definite natural region; our fauna is almost exactly identical with that of Western Europe in general; but I believe that the same is also the case with the flora. As far as birds are concerned, we have only one species—the red grouse—which can be considered peculiar to Britain, and a few sub-species, such as the British forms of the long-tailed, and coal titmice. Our mountain and winter birds are all but identical with those of Northern Europe, and our lowland and summer birds with those of Central Europe — the principal difference being, that our British list is poorer in the number of species. It is generally admitted by zoologists that the whole of Europe, Africa (north of the Sahara), Asia Minor, and Palestine and Arabia, and all Asia north of the Himalayas and the Yangtse Kiang basin, form one large natural zoological region. This is divided into two sub-regions, by drawing a line southwards down the Ural Mountains to the Persian Gulf, into the Eastern and Western Palæarctic sub-regions.

It would indeed be strange, in face of this system, if the fauna of our islands were thought to be worth studying independently, seeing the facility with which birds can, under favourable circumstances, and do habitually, make nothing of its boundaries.

It is to our manifest disadvantage, therefore, if we attempt to restrict our studies to mere local matters. Our scientific horizon is, of necessity, in that case a very narrow and limited one, if we steadfastly ignore all the rest of the world. To take an example, there are a certain number of birds which

visit us only in the winter—let me instance the fieldfare, redwing, brambling, and short-eared owl (as we are inland folk mostly)—which take up their quarters with us during a few months in the year, and regularly every year. What do we know of them on the whole? We can recognise the bird when we see it, perhaps; its note, perhaps; we know what it feeds on, perhaps—while it is with us; what more? Perhaps we religiously buy its eggs, or what pass for its eggs—we cannot be sure—because it is classed as a British bird; we have a specimen or two mummified in a glass case, with a number of incongruous vegetables and insects. But what do we know of it on the whole? Truly, very little. So with the birds which visit us in the summer, after these others have taken their departure, which visit us for reasons, perhaps, which they could hardly explain if they could speak, but would be driven to take refuge in an answer which many men are apt to bring up as a triumphant reserve (though, to my mind, a very irrational, and often unsatisfactory one) when they are required to give a reason for half the things they do—"My father, my grandfather, and my great grandfather used to do so, and that is enough for me." We know the summer birds' notes and appearance, perhaps; we examine their nests, and know what sort of places to expect them in; we even know their range in Britain, perhaps. As to where they go when they leave us, what is their range in Europe and in the world generally, whether their habits are different in other lands, the species closely allied to them, and their differences in appearance and habits and range from these—to all these things, which go to make up what strictly deserves the name of scientific knowledge—to such matters we are, too often, profoundly indifferent. And again I am constrained to remark, pity it is so.

We should, undoubtedly, have a far higher claim to the possession of true scientific knowledge if we were to confine our attention to one moderate-sized genus of mammalia, birds, insects, mollusca, or plants, and worked out the distribution of that genus in the world—zoologically (or, in the case of plants, botanically) and palæontologically—and familiarised ourselves with every member of that genus, its area, economy, habits, and uses, than by ever so general a study of the whole class as exemplified only in Great Britain.

And that leads me to express my wonder why we do not pursue our studies abroad more. All professional and commercial men nowadays have, more or less, their holidays, if nothing more than a few days at Easter, Whitsuntide, and Christmas. In these days of cheap and rapid travelling, why

do we not take more advantage of it? Many of us could manage a birds'-nesting trip, or a plant or insect hunting trip, or a foreign geological tour of a few days to Holland, or France, or Spain, or Switzerland, under the wing and auspices of Mr. Cook and his brethren. But, I think, you will agree with me that it is an exceptional circumstance for English naturalists to do so. When we English do go abroad it is, as a rule, to rush, guide-book in hand, through a given number of cities, like a whirlwind; or to pound resolutely along a lot of dusty highroads on a bicycle, happy if we can do our fixed number of kilométres in the day—robbed of all interest in our dinner if we fall short of the allotted distance —bringing back with us no very definite idea, save that we have "done" so many towns or miles in so many hours. Is not this a legitimate caricature of the British tourist? But could not we naturalists—at Whitsuntide, for instance—get a few days in a new field, with a trusty companion, and add to our storehouse of facts and observations, or even to our cabinets, experiences which might be a valuable possession to us for the whole of our natural lives.

But why do we so often prefer to, what I must call, *waste* a fortnight or three weeks at home, in some semi-fashionable sea-side town or inland watering-place—doing nothing whatever, and trying to fancy we like it—paying dear for ill-cooked meals in stuffy lodgings or a racketty hotel—when the same expenditure would have given us (unless our number of olive branches is abnormally large) a far more delightful and equally health-giving tour in Norway or Italy, from which we might have returned with, for example, a whole bale of dried plants, enough to occupy, with absorbing interest, all our unemployed evenings through the next winter, and forming a valuable item in our collection of reference?

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

EDWIN LEES IN HAST. "ILL. NAT. HIS. WORC.," *continued.*

(Continued from page 207.)

* **Iris fœtidissima**, 150. Near Alfrick, and at the western base of Crookbarrow Hill. Also about Pershore, in woody places. S.G.

* **Crocus vernus**, 150. Very rare. Several plants were found a few years ago in the middle of a meadow between Worcester and Crookbarrow Hill, by Mr. James Goodman, who pointed them out to Mr. Lees. L.M.

* **Narcissus Pseudo-Narcissus**, 160. In a wood at Little Malvern, and covering a whole meadow between Malvern and Cradley. Severn meadows at Kempsey, and in a wood at the Nash, near Kempsey. S.G. L.M.

* **N. biflorus**, 159. In an orchard beyond the Ketch, perhaps a suspicious place; but truly wild and abundant on the banks of Sapey Brook, near a travertine rock called the Hoar Stone. Mr. Lees. In a pasture at Bagnall, near Kempsey. Dr. Streeten. S.G.

‡* **Galanthus nivalis**, 159. Occupying the virgin turf in a glen at the northern base of the Herefordshire Beacon, apparently wild. *This locality must be in Hereford.* S.G. L.M.

* **Paris quadrifolia**, 162. In deep shady groves, at Witchery Hole, near Clifton-on-Teme; woods at Malvern, Eastham, Stanford, &c. S.G. L.M.

* **Convallaria majalis**, 160. Abundant in Shrawley Woods. More sparingly in Bewdley Forest. S.G.

* **Tulipa sylvestris**, 160. Very rare. In a little copse on the red marl bank at the Ketch, near Worcester. Mr. Lees. S.G. L.M.

* **Ornithogalum nutans**, 160. In a meadow near Kempsey Grove. S.G.

O. umbellatum, 160. In a meadow near Dr. Berkley's, at Cotheridge. Mr. Walcot.

* **Allium vineale**, 160. Pitchcroft. S.G.

* **A. oleraceum**, 160. Abundant on the Ketch Bank. With double heads of bulbs at Battenhall, near Worcester. S.G.

* **A. ursinum**, 160. Very abundant in Ockeridge Wood, near Holt. In various other moist coppices. S.G.

* **Colchicum autumnale**, 161. Abundant in almost every moist meadow in the county. S.G. L.M.

Luzula congesta (*L. multiflora*), 160. Perry Wood. Hartlebury Common.

* **Juncus uliginosus** (*L. supinus*), 160. Hartlebury Common, Malvern Hills.

* **Eleocharis acicularis**, 151. Bogs at the foot of the Malvern Hills, in several places. S.G.

* **E. palustris**, 151. Banks of a pool at Kinnersley. Dr. Streeten.

* **Scirpus sylvaticus**, 151. By the large pool in Shrawley Wood. Mr. Lees.

* **Eriophorum angustifolium**, 151. Abundant in a large bog on Hartlebury Common.

* **E. polystachion**, 151. Bog at the base of the Worcestershire Beacon, Malvern. L.M.

E. angustifolium and E. polystachion are the same species.

* **Carex pulicaris**, 177. In a bog at the base of the Worcestershire Beacon, Malvern, and on other parts of the Hills.

* **C. stellulata**, 177. With the above.

* **C. muricata**, 178. Bredon Hill, &c.

* **C. remota**, 178. In woods at the base of the Malvern Hills.

C. axillaris, 178. Banks of Sapey Brook. In a bog at Wyre, near the Avon.

* **C. pendula**, 178. In great abundance in Wayman's Wood, Clifton-on-Teme. Also by a rill, near Elmley Castle. Mr. Lees.

† **C. Œderi**, 178. Spring by the road side, near the Turnpike beyond Great Malvern. Dr. Streeten.

This is not the true C. Œderi, but C. flava var. minor of Townsend, C. lepidocarpa of some authors.

* **C. ampullacea**, 178. Banks of the Salwarp. Pool on the eastern side of Hartlebury Common.

* **C. vesicaria**, 178. Pool at Glasshampton, and at Ham Castle. Mr. Lees.

* **Phalaris arundinacea**, 151. Banks of the Severn, Kempsey, &c.

* **P. canariensis**, 151. Near Gregory's Mill, Worcester.

Alopecurus agrestis, 151. Corn fields, at Brook-end, near Kempsey.

A. geniculatus, 151. Severn meadows, Kempsey.

* **Arundo** (*Calamagrostis*) **Epigejos**, 152. Eastern side of Perry Wood.

* **A. Phragmites** (*Phragmites communis*), 152. By the side of brooks, and marshy places, at Hindlip, near Worcester, and on the banks of the Avon.

* **Milium effusum**, 151. Woods and groves. Perry Wood. S.G.

* **Aira flexuosa**, 151. Malvern Hills. S.G.

* **A. caryophyllea**, 151. Shrawley Wood, Malvern Hills, &c. L.M.

* **A.** (*Kœleria*) **cristata**, 151. On the red marl cliff at the Ketch, two miles south of Worcester. Dr. Streeten.

Melica nutans, 152. In Bewdley Forest, not far from Dowles Brook.

* **Glyceria aquatica**, 152. Pools and ditches in the vicinity of the Severn.

G. rigida, 152. Near the Ketch, on the Bath Road, between Kempsey and Worcester. Dr. Streeten.

* **Festuca pinnata** (*Brachypodium pinnatum*), 152. Near Pershore. S.G.

* **F. sylvatica** (*B. sylvaticum*), 152. Perry Wood, Shrawley Wood, &c.

Bromus asper, 152. Perry Wood.

* **B. diandrus**, 152. Severn Stoke. *Probably only a repetition of the record by Stokes.* S.G.

B. racemosus, 152. Severn meadows, Kempsey.

* **Nardus stricta**, 151. On Hartlebury Common, and Malvern Hills. S.G. L.M.

* **Blechnum boreale**, 180. In Bewdley Forest, on Bromsgrove Lickey, Stagbury Hill, in Shrawley Wood, and at the base of the Malvern Range.

* **Asplenium Ruta-muraria**, 180. On an old wall bounding the "Dark Alley," near the Cathedral. Also on walls at Martley and other places.

A. viride, 179. Found by the late Mr. T. B. Stretch growing on Ham Bridge, near Clifton. It is, however, eradicated, for some improver has plastered a coat of whitewash over every part of the bridge. *This the first notice of the habitat. The fern was not eradicated at the time supposed. It was seen by Mr. Edward Newman in 1843 ("Phytologist," Vol. I., p. 671), and I possess a specimen gathered by myself from the same spot, on the 31st August, 1844. Mr. Lees tells us in his "Botany of Worcestershire," p. 87, that the Herbarium of the late Mr. T. B. Stretch, of Worcester, passed through his hands in the year 1827, and that he observed in it a specimen of Asplenium viride, "with the habitat of Ham Bridge;" also that it disappeared in 1858 in consequence of a renovation of the structure, and that the late Mr. Haywood, seedsman and florist of Worcester, seeing the fern prostrate in the road, carried it home and planted it in his fernery at Wick.*

A. Adiantum-nigrum, 180. On the rocks of the Malvern Hills, abundantly though small. In shady lanes on the west side of Worcester, and at Kempsey growing very luxuriantly. With variegated fronds on Rosebury Rock.

* **Aspidium** (*Athyrium*) **Filix-fœmina**, 179. In abundance round the springs of the Malvern Hills, especially in the glens at the base. St. Catherine's Well, Sapey.

A. irriguum, 179 (*a form of the last*). In the bog at the base of the Worcestershire Beacon, Malvern.

* **Scolopendrium Ceterach** (*Ceterach officinarum*), 180. Rare in this county. On Malvern Abbey Church. Walls at Badsey.

* **S. vulgare**, 180. Not uncommon in moist places.

* **Cystea** (*Cystopteris*) **fragilis**, 179. In the neighbourhood of Bromsgrove. Mr. Maund.

This is probably the same habitat as that recorded by Miss Read, in Withering, 3rd Edit., 1796, p. 779.

* **Aspidium aculeatum**, 179. Very abundant in the stony lanes about Suckley.

A. lobatum, 179. Growing magnificently in the shady dingles by the Spout Brook at Eastham.

A. angulare, 179. In the woods at Suckley and Leigh Sinton.

* **A. spinulosum**, 179. About Bromsgrove Lickey. Also at Blackstone Rock.

* **A. dilatatum**, 179. Abundant on the declivities of the Malvern Hills, and among moist thickets in the valleys below. Also at the base of Bromsgrove Lickey, and on Blackstone Rocks.

* **A. Oreopteris**, 179. At the western base of the Worcestershire Beacon, Malvern. Messrs. Walcot and Lees.

Polypodium Dryopteris, 179. In considerable plenty among the loose stones occupying the glen between the North and End Hills, Malvern; pointed out by Mr. Salisbury.

What Mr. Salisbury is here referred to, or when he pointed out the fern, Mr. Lees does not inform us. It was still growing in the same locality, and on the western declivity of the Worcester Beacon, in 1867 and 1868, as stated by Mr. Lees in the "Botany of Worcestershire," p. 75, and in the "Botany of the Malvern Hills," 3rd Edition, 1868, p. 118. It has since been eradicated.

† **P. calcareum**, 179. In the same vicinity, according to Mr. Salisbury. *An error. "The true P. calcareum has not hitherto been found," Ed. Lees, "Botany of Worcestershire," p. 75.*

Lycopodium inundatum, 180. In the large bog on Hartlebury Common. Mr. Lees.

* **Equisetum palustre**, 180. Hartlebury Common, bog at Wyre, &c.

E. fluviatile, 180. Boggy glen near Crookbarrow. Also at Alfrick, Malvern, &c.

Equisetum fluviatile of Smith is E. Telmateia, Ehrh.; E. maximum, Lam. The latter is the plant intended; see "Botany of Malvern Hills," 2nd Edit., p. 84.

Several of the plants noted in the "Strangers' Guide" and in "Loudon's Magazine" do not reappear in the above catalogue.

Among the former are Lonicera Caprifolium, Hordeum sylvaticum, and Ornithogalum pyrenaicum, which is replaced by O. umbellatum. Among the latter are Cuscuta Epithymum and Mentha viridis. It is strange that Mr. Lees should have overlooked Perry's list, although it appeared in "Loudon's Magazine" in 1831.

(To be continued.) p 275

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(Continued from page 203.)

The same graving tools of nature which removed the upper measures have also cut deeply into the Limestone itself, producing those lovely and picturesque dales which render our Derbyshire districts so beautiful.

We are thus enabled to form some idea of the immense amount of material which has been denuded from the central portion of the Pennine area. We have had swept away the whole of the Coal Measures, the Millstone Grit, Yoredale Shales, and a variable thickness of the Mountain Limestone itself, which must represent in the aggregate at the very lowest estimate 10,000 to 12,000 feet of rock. If the elevatory forces had not been compensated by the sub-äerial waste, we should have had not *hills* in Derbyshire but *mountains*, raising their heads far above the snow line of this latitude.

Although it is pretty certain that our range of hills at one time reached a higher elevation than at present, it is unlikely that this ever equalled the total thickness of strata which have been removed from its central portions; for we have reason to believe that the great upheaval was not the result of one sudden earth movement, but was brought about by a slow, gradual, and intermittent process, extending over a vast period of time. Under these circumstances those never-ceasing atmospheric influences, which are constantly at work through the agency of rain and river, must have commenced their wasting action as soon as the bottom of the Carboniferous sea was brought above the level of the water, and the erosion of wave and current would begin even before this. In this way the planing and sculpturing forces of nature almost kept pace with the upheaval, and the great anticlinal ridge was scarred, furrowed, and truncated from its earliest childhood.

We can trace the great north and south Pennine axis right through North Derbyshire into the West Riding of Yorkshire, a total distance of about 60 miles, but in the extreme north of the first mentioned county, the beds, of which the hills are composed, begin to bend over a little to the north, and this tendency increases rapidly as we travel further in the same direction. At the southern extremity, in the Weaver Hills, the Limestone is also seen to bend over gently, but in this case it is towards the south. It is evident, therefore, that we must to some extent correct our notion of this great anticlinal, which is not a mere arch of indefinite length, but a very long, low, elliptical dome of rock.

To return once more to the Yorkshire end of this dome, or *periclinal* as it is called, we notice that the north and south folding of the rocks gives place to great corrugations in a direction at right angles to this, that is east and west.

The result of this has been to bring up lower beds from beneath the Coal Measures, these latter having been entirely swept off north of a line drawn due east and west a few miles to the north of Leeds, as far as the Tees. These east and

west folds have impressed themselves on the physical conformation of the North of England, just as the great Pennine anticlinal has done further south; for to them is due that system of east and west valleys, with high separating ridges, which run across the moorlands of Yorkshire. Here also, just as further south, the upper parts of the folds have been denuded right down to the Mountain Limestone.

Having now briefly considered the structure of the Pennine Hills, we must turn our attention for a short time to the Central Midland District immediately south of the termination of the range, and I must ask you to accompany me in imagination to the summit of the Weaver Hills near Ashbourne. Here, at a height of 1,200 feet above sea level, we find ourselves on the southern extremity of the Pennine Range. If we look upon the range as the "backbone" of England, we are now standing upon what an anatomist would call its *terminal caudal vertebra*. To the north is all the rugged hill country of Derbyshire, but to the south, the country over which we look, stretched out like a map at our feet, is of an entirely different character, and consists of a gently undulating plain, which, elevated only 300 to 400 feet above the sea, is in fact the western extension of the largest plain in the world. When standing on Weaver we look towards the rising sun, if it were possible to extend our powers of vision to an indefinite extent, and allow for the curvature of the earth, we should find no mountain or hill to obstruct our line of sight until our eyes rested upon the Ural Mountains, which divide Europe from Asia. Broken only by the inconsiderable ripple of these mountains, this mighty plain extends across the whole of Northern Asia.

In Europe the strata underlying the plain are of much more recent date than those constituting the Pennine Chain. At the base of the Derbyshire Hills they consist of sandstones and marls belonging to the New Red Sandstone series, which, sweeping round the base of the hills, follow every curve and inlet, so as to suggest, what is actually the case, that they were deposited round the flanks of the older rocks at a time when the high land of Derbyshire had its southern coast line in the Weaver Hills.

Far away to the south and south-east we can discern, rising out of the sea-like plain, three tracks of elevated ground, which mark the position of the Coalfields of South Staffordshire, Warwickshire, and Leicestershire, respectively. In all three of these tracts Carboniferous Rocks are again brought to the surface in dome-like masses, from which the overlying New Red Rocks have been stripped by the waste

of ages. These Carboniferous Rocks doubtless owe their present position to the action of the same forces which elevated the Pennine Range. In the case of the Leicestershire Coalfield, upon the western edge of which our town of Burton is situated, I shall be able to give you some proof of the correctness of this statement, but I shall have little time to refer to the South Staffordshire and Warwickshire areas. I may state, however, that, unlike the Derbyshire district, in all three of these Coalfields we have occasional glimpses of the old sea floor upon which the Carboniferous Rocks were deposited; thus affording us valuable information in our attempt to reconstruct the physical features of the country at that very remote period.

On the eastern side of what we may term our home district of the Leicestershire or Ashby Coalfield, this old floor upon which the Carboniferous sediments were thrown down has been bared to the light of day, exposing in Charnwood Forest a large tract of some of the oldest rocks in the British Isles, consisting mainly of slates, grits, volcanic agglomerates, and syenite, and occupying a ridge of ground about eight miles long and five miles broad.

Although the elevation of the Charnwood ridge does not, in its highest point, reach more than 900 feet above sea level, it presents, especially when viewed from its eastern side, a bold, serrated edge, in strange contrast to the gently flowing outline of most of the other hills of the Midlands. Its jagged and craggy summit, under certain atmospheric conditions, has a strangely mountainous aspect, and has often been justly compared with a miniature Alpine range. This resemblance, after all, is not a fancied one, for the Charnwood Hills have all the characteristics of a true mountain range. It was pointed out, many years ago by the late Professor Jukes, that here, within a very small area, and without any laborious climbing, we can study at our leisure nearly all the geological phenomena afforded by mountainous districts. Although of very diminutive proportions as compared with the mountain chains of Europe, we must bear in mind that denudation has played its part here also, and that it is only a ruin of its former self. Its elevation, doubtless coeval with that of the Pennine Range, took place at a very remote period of the world's history. The now lofty chains of the Alps, the Pyrenees, the Andes, and, in fact, nearly all the important mountain ranges of the world are but mere children in point of age when compared with the venerable antiquity of our Leicestershire hill country. In fact, the Charnwood area had an elevation far in excess of its present height, and had

been subjected to denuding forces ages before the sedimentary rocks, which form the greater part of those mountain chains, had even been laid down in their ocean beds.

The Charnwood ridge has been produced by an anticlinal fold with its axis running N.W. and S.E. This fold has been ruptured at the crown of the arch by the great forces which brought about its elevation, and the western ridge has in consequence been forced some 500 feet higher than the eastern. Such a rupture, attended with the vertical uplift of the rock on one side of the great earth crack, is called a *fault*, and if it had not been for the constant planing action of sub-äerial forces keeping pace with the slow uplift, we should have had one side of the range elevated as a lofty wall of rock above the other side. As it is, however, nature has so planed the surface that the old scar is not visible, and can only be inferred from the want of correspondénce in the beds on either side of the anticlinal.

On the west of the Charnwood area the actual super-position of the Carboniferous strata upon their old sea bottom consisting of Charnwood Rocks, is not visible, owing to the existence of another large fault running parallel with the anticlinal fault, letting down the Coal Measures against the former. It is only on the north and north-west that the Mountain Limestone, the lowest member of the Carboniferous system, is found resting upon the Forest rocks; and here we find unmistakable evidence that the latter must have been immensely disturbed and denuded before the Limestone was laid down upon them. Such a super-position is known as an *unconformity*, in contradistinction to the term *conformity*, which is used to express an unbroken sequence of sedimentation, like, for instance, that of the various members of the Carboniferous system from the Mountain Limestone right up to the Coal Measures.

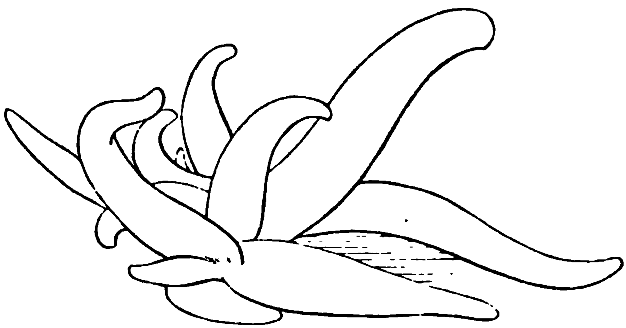
(To be continued.)

A CELLAR FUNGUS.

BY W. B. GROVE, B.A.

It is a striking fact that some fungi, when grown in dark or unventilated places, assume a form quite different from their normal one. The significance of this fact has not, to my knowledge, been investigated. There is a tough Agaric-like species, *Lentinus lepideus*, which was probably originally introduced into this country by foreign timber, in

which this transformation is frequently observed. Although it has been met with, it is said, on native timber, it usually grows on deal, and especially on rafters. It sometimes occurs in great numbers under railway bridges, if these are made of wood, but it is more common in cellars, growing on the rafters which support the floor above. It consists of a stem and pileus, like the common mushroom, but of a pinkish hue, the latter bearing white gills on its lower surface. Now the gills of the Agarics have, as is well known, a tendency to turn away from light. But the stem of the Lentinus, from the necessity of its position, grows at first downwards, and if it developed the pileus at its end in the usual way, the gills would be turned upwards and therefore most likely to receive what light there might be. To avoid this, the stem curls round, and at last points upwards, describing a complete semi-circle, and thus placing the gills in the normal position. But far more frequently, if the cellar has but little light, the pileus remains undeveloped, and the stem, even after it has curled round, terminates in a sharp point.



A more common and more complicated instance of this monstrosity, however, is found in *Polyporus squamosus*. This is the large coarse species so frequently found growing in tufts on old ash trees, though also on willow, elm, etc. It has a short, thick stem, invariably black at the base, and expands into a yellow pileus of the shape and consistency of a saddle flap, bearing on its under side a coarsely reticulated surface or mass of hexagonal yellow pores. It reaches an enormous size; clusters have been found measuring 7 feet 8 inches in circumference, and weighing 84lbs. But in cellars and other confined places, such as hollow trees, it often assumes a widely different form. In such cases it is usually the stem alone that is developed, although sometimes

there is an attempt at the formation of a pileus in patches. The stems may remain single, forming therefore a tuft of horn-like growths, blackish at the base, and yellow towards the points; but they may also branch, and this repeatedly, so as to resemble coral, or may give off lateral branches, and thus assume the likeness of the antlers of a deer. A beautiful instance of this was figured in Bolton's "Funguses growing about Halifax," about a hundred years ago, under the name of *Boletus rangiferinus* (pl. 188); and another, two feet high, was figured in the Philosophical Transactions by Professor John Martyn (vol. 48, pl. 2, f. 1). The one of which a figure is given above was sent to the Birmingham Natural History Society by R. S. Bartleet, Esq., J.P., of Redditch; it grew on a block of elm wood which has been for several years fixed in the floor of a rather damp room in his factory. It belongs to the unbranched form, and the whole tuft, which was about seven inches high, sprung from a crack in the wood less than half an inch in width.

Mr. Bagnall informs me that some years ago he received from Mr. Charles Parsons a beautiful specimen of *Polyporus squamosus*, found in a wine cellar at Edgbaston, similar to that figured by Bolton under the name of *Boletus rangiferinus*. This had a dark coloured base about six inches wide, and from this arose a number of clavaria-like processes, some of which were branched. These clavaria-like branches were from three to six inches long, and were of a pale fawn colour. A smaller example of this was also sent from a warehouse in Birmingham; this was found growing on the rafters on taking up a portion of the floor for repairs. He also received from Mr. Parsons what was probably a state of *Lentinus lepideus*. In this case the stem only appeared to have been developed, and had assumed the form of a delicate semi-transparent shell; it was about six inches long, and pearly white in colour. This was also found growing in a wine cellar at Edgbaston.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Continued from page 214.)

And think of these things, too, from a social and political point of view. Side by side with this growth in population,

and this wonderful revolution that has been brought about by railways, and steamships, and telegraphs, how we have been growing gradually more and more luxurious in our habits of daily life, and how the spread of education and the popularisation of art, and the enormous increase that has taken place in the last generation in the number of those who possess incomes of moderate competence, have increased the quantity and quality of the things which as a nation we consider that we need to enable us to live our daily lives in contentment and comfort; and how that now more than ever the mass of the nation will have an influence in making the laws and controlling the great issues of our national, foreign, and colonial policy.

Reflect upon the melancholy testimony borne also by the historic record; how, through man's greediness, improvidence, and quarrelsomeness, many of the countries which supported the great nations of antiquity have been robbed of their natural beauty and fertility. Pass round the basin of the Mediterranean and compare the state of things now with what it once was, in Persia, in the valleys of the Euphrates and Tigris, in Syria, Palestine, Asia Minor, and Greece, in Northern Africa, in Cyprus and Sicily, and, in a lesser degree, in Spain and Italy. Everywhere we find the same sad contrast of wide tracts of country that were once fertile cornland now changed to sandy deserts and pestilential marshes; aqueducts and roads ruined by neglect and violence; vineyards and olive gardens, and groves of date palms, ruthlessly destroyed, and mountains that once were sheltered by groves of oak and pine and chestnut changed to bare stony ridges, of which the water-springs have been dried up and the grassy sward parched away, and the coating of alluvial soil which the roots of the trees kept in its place carried away by the rain to silt up the rivers and harbours of the lowlands. Contrast the Carthage of Regulus and Scipio Africanus with the Tunis of to-day; or the Cyprus that was ruled by the Venetians, when the island maintained a population of one million, to the Cyprus which was handed over a few years ago by the Turks to the English, when the population had sunk to 140,000; or the Lebanon of to-day with the Lebanon of Hiram and Solomon; or the Assyria of to-day with the Nineveh of Jonah, Sennacherib, and Asurbanipal; or the Babylonian plain as it is now with what it was in the days of Nebuchadnezzar and Belshazzar.

We are told by Herodotus that the walls of Babylon were a square fifty miles in circumference, and that the Babylonian territory supported, not only its own resident population, but

also the whole retinue and army of the Persian king for four months in the year; that one of the Satraps owned 16,800 horses, and that his dogs were so numerous that four large villages were excused from all other taxes on condition of supplying them with food. He says that the soil of the Babylonian plain was so fertile that of wheat it yielded a return of two or three hundredfold, that millet and sesamum grew to a great size, and that over the whole plain the date palm flourished, bearing fruit abundantly. Now for centuries the plain has been a sandy desert, without any regularly-settled inhabitants, and the visitor sees only a few Arab tents and frail reed-huts, furnishing an impressive contrast to the ruins of the great walls and temples; the only trees now a few willows and tamarisks along the river, and here and there a spiny acacia scattered over the sand.

Recent Changes in Area of Growth of Common Economic Plants.

About the plants that have been cultivated for many centuries, such as the vine and the hop, the cereal grasses and the common fruits and timber trees of the north temperate zone, the farmers, gardeners, and foresters, who have been working at them for generations under every phase of growth and every modification of soil and climate know far more about their different varieties and the situations they need in order to be grown successfully than botanists, whose attention is not concentrated upon the plants which are specially valuable from an economic point of view, which do not number more than perhaps one hundred species out of the one hundred thousand with which the botanist has to deal. But even of most of these during the last generation, as population has increased and the carrying trade has been completely revolutionised by steam and electricity, the countries in which they are grown have been changed very materially. The total amount of foreign food imported into Great Britain in 1864 was an average of twenty-five shillings per head. In 1888 it amounted to sixty-nine shillings per head, the difference representing a lump sum of seventy-seven millions of pounds per annum. In 1864 the total amount of foreign grain and flour imported into the country was worth twenty millions of pounds sterling. In 1888 it cost seventy millions, an increase of fifty millions in twenty years.

Before the war of secession in the United States, the Southern States had almost a monopoly of the trade in raw

cotton. Last year the value of the raw cotton exported from India was between fourteen and fifteen millions of pounds sterling. In 1840 China had a monopoly of the tea trade. In 1883-4 the value of the tea exported from India was 408 lakhs of rupees, or over four millions of pounds sterling. In 1850 the area under cultivation for tea in India was not more than a thousand acres, yielding an annual crop of 250,000 pounds. In 1880 the area under cultivation was 206,700 acres, yielding an annual crop of forty millions of pounds, representing an invested capital of £15,000,000, an annual expenditure of two millions in wages, and, at the rate of five to an acre, yielding means of subsistence for over a million natives. The annual export of coffee from Ceylon, instead of being as it was in the years between 1865 and 1878, five millions sterling a-year, has now dropped to a million and a half.

The Recent History of a Tropical Colony.

Take a tropical colony like Ceylon, and study how all the conditions of life there are revolutionised by the entrance of the irrepressible Anglo-Saxon. In 1837, when coffee-planting was started, Ceylon was a mere military dependency, with an annual revenue amounting to £372,000, or less than the expenditure, costing the mother country a good round sum every year, the total population not exceeding one million and a half, but requiring nearly 6,000 British and native troops to keep the peace. Now we have the population increased to two millions and three quarters, with only 1,200 troops, all paid for out of an annual revenue which exceeds £1,300,000; a people far better fed, educated and cared for in every way. The total export and import trade since planting began, has expanded from half a million sterling to eight or ten millions, according to the harvest. During the forty-five years referred to some thirty or forty million of pounds have been paid away in wages earned in connection with the plantation to Kandyan axe-men, Tamil coolies, Singhalese carpenters, domestic servants, and carters. Over 200,000 Tamil coolies were saved from starvation in Ceylon in the Madras famine in 1877-78.

According to official papers there are more than sixteen million of people in Southern India, whose annual earnings, taking grain and rice at its full value, do not average per family of five more than £3 12s. a-year, or about a halfpenny a-head per day. In Ceylon each family can earn from nine shillings to twelve shillings a-week and save half or

three-quarters of that amount. Our calculation is that from each acre of coffee or tea land kept in full cultivation five natives (men, women, and children), derive their means of subsistence. It is no wonder that with a population nearly doubled during the planting era, four or five times the quantity of cotton cloth is consumed, and ten times the former quantity of food is imported into the island.*

How a Botanic Garden can help the Colonies.

It is in selecting the plants for new colonies or old ones that have been ruined by neglect, or in helping to bring into cultivation plants valuable economically that run the risk of being exterminated in their native localities, that the help and advice of a botanic garden is required, particularly for the correct identification of the best species. Take for instance cinchona, india-rubber, and gutta percha.

Cinchona.—In temperate climates quinine is one of the most useful of drugs, and in tropical climates it is now used universally in curing and warding off fever. Quinine and its allied alkaloids are the product of the bark of trees of the genus *Cinchona*, which is restricted in a wild state to a narrow belt of the Andes of South America at an elevation of between 2,000 and 8,000 feet above sea level, particularly along their eastern declivities, from latitude 19° S. in Bolivia to latitude 10° N. in Venezuela. Here of course they are very difficult of access, and they are getting destroyed rapidly, *C. succirubra* for instance, which was found formerly in all the valleys that open on the plain of Guyaquil, is now almost confined to the western slopes of Mount Chimborazo.

In 1860 an expedition was sent out under Mr. Clements Markham, to the Andes, to procure living plants and seeds for conveyance to India, and, after many adventures and disappointments, its efforts were crowned with success. There are in the genus about thirty-six species, differing from one another in their climatic constitution, and still more in their economic value; but they are very difficult of botanical determination, because the primary types are linked to one another by puzzling intermediate forms.

The Dutch sent out an expedition to the Andes under Hasskarl in 1854, but unfortunately a large proportion of the plants which they obtained proved to belong to *C. Pahudiana*, a species of very small medicinal value. In the Indian plantations four distinct species have been planted

* "Ceylon," by W. Ferguson, F.L.S., pp. 83, 84.

extensively:—1. *C. succirubra*, which yields the red bark of commerce, yielding about 5 per cent. of alkaloids, quinine and cinchonine in almost equal proportions, which thrives at a lower elevation than the three others, but it is specially sensitive to frost, and long-continued drought; 2. *C. micrantha*, which yields the grey or silver bark, also poor in quinine, but rich in cinchonine; 3. *C. Calisaya* and its variety, *Ledgeriana*, which yields the royal, called also the yellow or Calisaya bark, the richest of all in alkaloids, of which quinine forms half or three-quarters (not less than 2, and in exceptional cases as much as 10 per cent. of quinine); and 4. *C. officinalis*, which yields the pale, or loxa, or crown bark, containing ½ to 1 per cent. alkaloids, of which more than half is quinine.

(To be continued.)

Wayside Notes.

Leafing of Oak and Ash.—The continuous and welcome sunny days of the end of May induced an unusually rapid development of the foliage of both oak and ash, so that the relative opening was not so marked as in any year during the last six or seven seasons. A large number of trees were carefully observed in S. Beds. and N. Herts., especially where they were growing in company, and in the great majority of cases oaks were before the ashes; it was only exceptional, possibly ten per cent., where the reverse was the case. Bearing in mind the constitutional differences of individual trees, I see no reason for reversing the opinion before expressed in the "Midland Naturalist," that oak trees as a whole leaf before the ash trees.—J. Saunders, Luton. June, 1888.

P.S.—It is worthy of note, as bearing upon the old adage, that this season, in which the ash trees were more nearly synchronous with the oaks than usual, has been followed by a remarkably wet summer. —J. S. August, 1888.

Freshwater Algæ.—This beautiful and interesting class of plants is not as much studied as it deserves to be. It offers an ample field for discovery to any one with a microscope and good eyesight. The Council of the Leicester Literary and Philosophical Society have recently purchased the splendid collection of Mr. F. Bates, of Leicester, comprising nearly 1,800 microscopic slides, mostly prepared by himself, with admirable skill, and representing about 399 British and 19 foreign species. A number of the British species, supposed to be about 60, are not yet identified or named. The Council are anxious that this fine collection should be turned to account for the general benefit of science, and if any student desires to make use of them, an application to that effect would be favourably considered.

Bristol Hill, Leicester. F. T. Mott.

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS.

NAME.	DATE. 1888.	ASPECT.	SITUATION, &c.
Corylus avellana	Jan. 29	N.	Hill top, both sexes of flowers open.
Mercurialis perennis ..	Feb. 12	S.	Bank, foliage and *buds* only.
Tussilago Farfara ...	Mar. 3	S.	G. N. R., several blossoms.
Petasites vulgaris	„ 4	Open.	Boggy meadow, one spike only, which was nipped by frost. See below.
Mercurialis perennis ..	„ 25	S.	Hedge bank.
Cardamine hirsuta	„ 30	S.W.	Side of a brook.
Ranunculus Ficaria ..	„ 30	Open.	Boggy meadow.
Petasites vulgaris	„ 30	„	Plants not generally in blossom till about this date. See above.
Helleborus viridis	April 1	„	Meadow, numerous blossoms.
Salix capræa..........	„ 7	W.	Coppice.
Caltha palustris	„ 13	Open.	Moist meadow.
Ulmus montana	„ 15	„	
Anemone nemorosa ..	„ 15	„	Coppice.
Poten. Fragariastrum..	„ 15	W.	Bank.
Primula veris	„ 21	S.E.	Hill side.
Nepeta Glechoma	„ 28	Open.	Rough ground.
Prunus spinosa	„ 29	„	Hedge, only a few flowers open.
Adoxa Moschatellina ..	May 6	N.W.	Bank.
Ranunculus bulbosus..	„ 9	S.E.	Pasture.
Stellaria Holostea	„ 12	W.	Bank, plentiful.
Sisymbrium Alliaria ..	„ 12	„	Do. do.
Cardamine pratensis ..	„ 12	Open.	Meadow, plentiful.
Scilla nutans	„ 13	N.E.	Bank.
Viola Riviniana	„ 13	W.	Bank.
Geranium Robertianum	„ 21	S.W.	Hedge bank.
Vicia sepium	„ 21	„	Do. do.
Cratægus monogyna ..	„ 31	„	Do. do.

The excessive cold of the early months of this year rendered the records very meagre till near the end of March. Dog's Mercury, March 25th, I have known in blossom by the first of January; Coltsfoot, dated March 3rd, has been in blossom late in January in the same station, which has been under observation for six or seven years; while Butterbur, which showed one blossom March 4th, was retarded by frost for quite another fortnight. Barren Strawberry, sometimes gathered in January, was searched for carefully, but was not observed till April 15th.—J. SAUNDERS, Luton.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION, July 28th. The eleventh half-yearly field meeting of the section was held at Evesham. The members (numbering sixteen) assembled at New Street Station at 1.50, and took train to Evesham, where they were joined by Miss Gingell, Mr. Slatter, Mr. Cullis, and Mr. F. Hughes, making the number up to twenty. Notwithstanding the rain which descended in a continuous downpour, the party, conducted by Mr. Slatter, walked through the town, and inspected the Parish Room, the two Chapels of All Saints and St. Lawrence, the Cloister Arch, and the Bell Tower. This last is a magnificent campanile, built by Clement Lichfield, the last real abbot of Evesham. It is one of the finest examples of late Gothic architecture now extant, and is in an excellent state of preservation. From the abbey the section proceeded to the residence of Mr. Slatter, and examined his extensive and valuable collection from the inferior oolite; and from thence repaired to the hotel, where tea was provided. At six o'clock the chair was taken by the President, Mr. W. R. Hughes, F.L.S., who, after welcoming the visitors, read a letter from Mr. Herbert Spencer, inquiring after the welfare of a society established for the study of Sociology in Paris by M. Grosclande, C.E., and enclosed a communication from Mr. Skelton, of Brooklyn, U.S., announcing the opening of a society there, on similar lines, in connection with the second Unitarian Church of Brooklyn. The President then called upon Mr. Howard Pearson to read his paper on "Simon de Montfort." Mr. Pearson, who was cordially greeted on rising, after tracing the origin and history of the Montforts, said that Simon was one of the fathers of our constitutional liberty who had done great and lasting service to the English people, and who was not recognised according to his deserts. He was the one man of his age who understood the spirit of the English nation, yet he was passed over, by those who neither knew nor cared to whom they owed their liberty of speech, as a foreigner who failed. In 1258, when the vacillation and weakness of Henry III. had brought the people almost to a state of rebellion, a parliament was called, meeting at Oxford, from which issued the famous provisions of Oxford, by which the government was placed in the hands of a council. Twelve representatives of the Commons were to be called to the parliament, which was to meet three times a year, "summoned or not." Later on, at the period when Henry and Prince Edward were prisoners of Simon de Montfort, he took the momentous step of admitting the Commons to a still larger share in the government of the country, and summoned each town to choose and return two burgesses to be their representatives, which still abides the unalterable basis of our liberties. He was idolised by the Commons, revered by the Church, and held as a saint. His friends were passionately devoted to him, and amongst the little band which preferred to meet death rather than live without him, we have pride in numbering William, Lord of Birmingham. At the conclusion of Mr. Pearson's paper, the President called upon Mr. Slatter, who gave an address on "The Geology of the Vale of Evesham," tracing the succession of the strata, and giving an account of their characteristic fossils, and their relation to the physical geography of the neighbourhood. A vote of thanks to Mr. Howard Pearson for his admirable paper, proposed by Mr. A. Browett and seconded by Mr. Chase, and a vote of thanks to Mr. Slatter for his interesting and instructive address, and for his courtesy in conducting the party and permitting

them to examine his collection, proposed by Mr. J. H. Lloyd, and seconded by Dr. Showell Rodgers, were both carried unanimously.—BIOLOGICAL SECTION, July 31st. Mr. F. Goode in the chair. The following were exhibited:—By Mr. F. Goode, *Cytisus laburnum*, in flower and fruit; by Mr. Bolton, for Mr. W. R. Hughes, F.L.S., a fine collection of polyzoa from Evesham; Mr. W. H. Wilkinson, lichens from Northampton Excursion, amongst which were *Lecidea albo-atra, Calicium hyperellum, Usnea rubiginosa, &c.*; by Mr. J. E. Bagnall, for Rev. T. Norris, a fine collection of rare plants from Loddington Wood, Leicestershire, amongst which were *Vicia sylvatica, Agrimonia odorata, Lathyrus sylvestris*; for Mr. J. B. Stone, F.L.S., flowering plants and mosses, from St. Bernard and Interlacken, the more rare being *Anemone sulphurea, Dryas octopetala*, and *Neckera cripsa* in fruit; for Rev. D. C. O. Adams, fungi, *Agaricus cervinus, Ag. rivulosus, Russula depallens*, from Ansty, near Coventry.—MICROSCOPICAL SECTION, August 7th. Mr. R. W. Chase in the chair. Mr. Marshall exhibited a specimen he had just brought from Norway of *Cotula coronopifolia*, a marsh plant of the composite order that was stated to be not found in any other country of Europe, and in only one locality in Norway. Also, the skin of a fish from Norway, having a brilliant blue colour, which was identified by Mr. Hughes and Mr. Chase as *Labrus bergylta*, the Ballan Wrasse, occasionally found on some parts of the coast in this country. Mr. Chase gave an account of an excursion he had just made to the East Coast, where he had been extremely fortunate from an ornithological point of view.—BIOLOGICAL SECTION, August 14th. Mr. R. W. Chase in the chair. Mr. W. B. Grove, B.A., gave a full and interesting account of his recent visit to Staffa, Fingal's Cave, Lewis, and other of the Western Isles, and exhibited a rare fungus, *Lachnella Rhytismæ*, from Lady Matheson's grounds, Lewis; he also exhibited the following fungi from Sutton: *Agaricus acute-squamosus, Peziza omphalodes, Leocarpus fragilis, &c.* Mr. J. Levick also gave additional notes of a tour in the Hebrides, and exhibited as part of the spoils, *Drosera anglica, Saxifraga aizoides*, and *Sphagnum contortum*. Mr. C. Pumphrey exhibited a fine specimen of the bladder nut, *Physalis Alkekengi*. Mr. J. E. Bagnall, A.L.S., exhibited *Gymnostomum rostellatum*, from Alcester, new to Warwickshire, and *Physcomitrella patens*, new to South Warwickshire, from Alcester and Wormleighton; also, for Mr. J. B. Stone, a number of rare mosses from the Swiss Alps, including *Cylindrothecium cladorrhizans, Barbula mucronifolia, Orthotrichum rupestre, &c.*; for Mr. C. Pumphrey, mosses collected during his visit to Norway, amongst which were *Tetraplodon mnioides, Hypnum loreum*; also *Jungermannia saxicola*; and for Miss Gingell, a large collection of rare and local plants, from Dursley, Gloucestershire, such as *Geranium columbinum, Aquilegia vulgaris, Melica uniflora*, and a series of specimens of *Paris quadrifolia*, having four, five, and six leaves in a whorl, giving also notes on their distribution, economic uses, and folk lore.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 23rd. Mr. P. T. Deakin exhibited a collection of land and fresh water shells from Hampshire, including specimens of *Balea perversa*, also a collection of fossil leaves from the Eocene beds of the same district; Mr. J. Madison, wing of a neuropterous insect, from the Rhaetic beds of Knowle; Mr. Corbet, slabs showing impressions of rain drops and ripple marks from the same formation. Mr. O. Hutchinson then read a paper on "The Green Slime, Protococcus." An examination of this object would show it to consist of a vast

number of green bodies from $\frac{1}{3000}$ to $\frac{1}{1000}$ of an inch in diameter. Its multiplication was very simple. The cells became elongated and depressed in the middle, a septum dividing them into two; this was crossed at a right angle by another septum dividing them into three or four cells. Its mode of reproduction showed it to have been probably an aquatic plant. Its food was taken from rain water, and sunlight was necessary for its development. The motile and immotile forms were spoken of as bearing a strong resemblance to some low forms of animal life. The paper concluded by referring to the profit and pleasure of tracing out the life history of any common form of alga or fungus.—July 30th. Mr. J. Madison exhibited a specimen of *Helix aspersa* var. *tenuis*, from Guernsey; under the microscope, Mr. J. W. Neville, parasite of *Limax flavus;* Mr. Rodgers, *Volvox globator*, from a tank in which he had kept it for three years.—August 13th. Mr. H. Hawkes exhibited the following fungi from Hamstead Park :—*Panus conchatus*, *Polyporus squamosus*, *Diachæa elegans*, *Craterium minutum*, and *Diderma vernicosum;* Mr. J. Madison, *Helix aspersa* var. *minor* and *H. virgata* var. *subalbida* and *albicans;* Mr. J. Collins, *Spiræa filipendula*, *Crithmum maritimum* and other plants from Somersetshire; under the microscopes, Mr. W. Dunn, *Melicerta ringens;* Mr. Collins, *Ceramium acanthonotum*.

DUDLEY GEOLOGICAL SOCIETY AND FIELD CLUB.—This Society held a Field Meeting on Wednesday, the 22nd inst., at Ankerdine Hill, Knightwick, on the Worcester and Bromyard line of railway. This hill, though not at all lofty, is considered the most picturesque hill in Worcestershire, commanding very extensive views in every direction, and as the day was very clear, the party were much delighted with the prospect, which included the Malverns, which show up grandly in their massiveness from this point; the Abberley range, the Titterstone and Brown Clees, Clent and the Lickey, Bredon and the Cotteswolds, with a distant view of the Sugar Loaf and Black Mountain. The hill is mainly composed of Upper Llandovery beds, which, being on the axial line of disturbance of the Malvern and Abberley Hills, are much dislocated and faulted against rocks of several later formations. Some of the bands are very fossiliferous, and contain innumerable casts of *Atrypa hemispherica*, and the delicate worm-tube, *Tentaculites annulatus;* but as the matrix is a rather coarse and loose sandstone, the specimens are very unsatisfactory. The botany of the neighbourhood is especially rich and varied, and, among the more rare species of plants met with, the following were determined by the Rev. J. H. Thompson and Dr. Fraser:—*Vicia gracilis*, *Hieracium murorum*, *Hypericum Androsæmum*, *Erythræa Centaurium* var. *flore albo*, *Cardamine impatiens*, *Geranium pusillum*, *Geranium dissectum*, *Conium maculatum*, *Malachium aquaticum*, *Sison Amomum*, *Origanum vulgare*, *Potentilla argentea*, *Matricaria Chamomilla*, *Pimpinella Saxifraga*, *Rhamnus catharticus*, *Cerasus austera*, *Poa nemoralis*, *Brachypodium sylvaticum*. In the course of the day the President, Mr. Horace Pearce, F.L.S., F.G.S., exhibited the following rare plants:—*Verbascum Lychnitis*, *Nasturtium amphibium*, and *Lythrum Salicaria*, from Whittington; *Sedum Rhodiola*, in fruit, from Snowdon; *Erica vagans*, from The Lizard, Cornwall; *Erodium maritimum*, from Habberley Valley; and *Tragopogon pratensis*, from lane, near Stourbridge. Mr. W. Madeley also exhibited a fine flint celt (*Palæolithic*), and two scrapers from river, Maidstone, of which he guaranteed the genuineness. The Society will hold a half-day meeting at Pouk Hill, Walsall, on Saturday, the 1st September, for the purpose of examining the Trap

rock, which is so well seen there, intruding into the coal measures, and charring the coal till it becomes a hard coke. The last meeting will take place on the 18th September, at Rock, near Bewdley.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, Mr. F. T. Mott, F.R.G.S. Evening Meeting, Wednesday, July 25th; attendance, nine. The Chairman exhibited a simple apparatus of wood marked with scales of inches and fractions for measuring the daily growth of plants. A discussion ensued as to the effect of light upon vegetable growth. Dr. Finch stated, on the authority of Sachs, that the shaded side of herbaceous stems grew faster than the sunny side, and that this was the cause of heliotropism. The subject is very complex, and offers a wide field for research. Mr. Palmer exhibited shells of *Planorbis corneus* and *P. carinatus*; Mr. Carter specimens of *Cardamine impatiens*, which had appeared as a casual in a garden at Stoneygate; Dr. Finch, specimens of *Viola lactea*, from Hampshire; the Chairman, a number of garden flowers with their foliage. The Chairman read a short paper "On the Results of Cultivation," showing that cultivation imparted no new faculty, but was simply an unfolding of hidden potentialities; that the cultivator supplied the conditions necessary for the development of some special tendency already existing in the plant, and that by supplying or withholding such conditions he could develop almost any part of the plant at will; that civilisation was impossible without cultivation, because vegetable as well as animal food was essential to civilisation, and nature provided vegetable food suitable for man only at certain seasons and in small quantities; and that most of our vegetable foods were, in fact, artificial productions.

SEVERN VALLEY NATURALISTS' FIELD CLUB.—The third Field Meeting of the season was held at Stokesay and Hopesay, on Tuesday, August 7th, and was attended by about thirty members. At Stokesay Castle the club was met by the Rev. J. D. La Touche, President of the Caradoc Field Club, who gave an interesting account of the structure and history of the building. After visiting the church, the club followed their guide to the slope below Yeo Edge, where Mr. La Touche sketched the solid geology of the district, with special reference to the origin of the Stokesay Valley, which cut across the strike of the Silurian rocks, the escarpments of Aymestry limestone facing each other on opposite sides. He also touched upon the history of the region in the glacial epoch. Dr. Callaway, President of the Severn Valley Club, followed with remarks upon the relations to each other of the older Palæozoic formations on each side of the great Church Stretton fault. He then outlined the recent views of the late Prof. Carvill Lewis, of Philadelphia, who held that in the glacial period a great ice-sheet flowed down the Irish Sea, sending a tongue across the plain of Cheshire to North Shropshire, where the ice terminated, and moraines and morainic lakes were formed. The club then took train to Broome, and, by the kindness of J. T. Barber, Esq., were conveyed in carriages to Hopesay, where they visited the encampment of the Hill of Barrow under Mr. Barber's guidance, and were afterwards hospitably entertained at a sumptuous tea by the Rev. R. G. Maul, the rector. The fineness of the weather, the interest of the geology, and the kindness of their guides and hosts, made the visit of the club most pleasant and instructive. The advantages enjoyed were largely due to the energy and influence of the Hon. Secretary, the Rev. R. C. Wanstall, R.D.

INSULARITY.

BY THE REV. H. H. SLATER.

(Continued from page 220.)

I hardly know to what to attribute this scientific insularity. Perhaps to the in-bred Conservatism with which most Englishmen are so profoundly imbued—however much they might be inclined to resent the imputation from a political point of view. But it says very little for us as a scientific nation, if we have not been able to emancipate ourselves from the trammels under which Gilbert White was compelled to study the natural history of Selborne a hundred years ago —if the times have marched, and foreign nations have marched with them, but our "scientific frontier" remains where it was.

And, when we come to look at the question in all its bearings, we must see what advantages we have over the rest of the world. Our scientific horizon might have been expected to have been such a broad and wide one. For we have colonies dotted all over the world, and countrymen resident in every part of the globe. On British soil the sun never sets. We might make our expatriated countrymen such numerous and useful contributors to our scientific knowledge, it might be thought, but in how wofully few cases is this a reality! It is a saddening reflection, but I am afraid we cannot gainsay its truth, that an Englishman stationed abroad lands at his destination with a fixed resolve to imagine, by a species of conventional fiction, that he is still resident at home. Excepting as far as his changed surroundings minister to his tastes from a strictly sporting point of view, his main object in his spare time seems to be to maintain a little England about him. As a rule he ignores the natives, except from the point of view of a political, commercial, or sporting adjunct, and his life abroad appears to bespeak his feelings thus:—"I am obliged to be out here on account of my profession or business, but I wish it to be distinctly understood that I had much rather be at home; and life here will only be so far endurable, as I can approximate it to that I have left behind me in England; I will therefore jealously stick to my tennis lawn, my cricket ground, and my race meeting, and I will have my polo and pic-nics and dinner parties after the British pattern. The country may be pretty enough, but I must have something to *do*.

And I have learnt to take an interest in so few things in this world (and those, we might add, such essentially artificial things) that I must go on to the end of the chapter in the selfsame groove in which I have hitherto been moving."

And so he stays out his allotted time, scorns the "niggers" by whom he is surrounded, cares nothing for, and learns very little of, the country in which he is domiciled, except, to take an example, the current value of the rupee, and the mad delight of pig-sticking, and comes back with a liver and an income large enough to enable him to go on leading the rest of his natural life on the same lines at home, and knowing far less of the natural features of the country than we might know ourselves without ever leaving England.

But are not we, "who live at home at ease," as the saying is, partly to blame for this state of things? Ought we not, when we send a son from our homes to the other side of the world, to have taken care beforehand that he should not be forced, in the absence of congenial and well-bred English society, to take his only delight in pleasures of the senses? Is it not partly our fault if he come back to England very much as he went out, a "returned empty." I think we owe it to those over whom we have influence—knowing from our own experience the civilising and tranquilising influence of the particular tastes we ourselves affect—to do our best, as a personal duty, to see that they shall not incur the danger (and it is a great danger) of being thrown upon their resources in a foreign land, without being able to reckon amongst those resources at least one wholesome and intellectual pursuit—especially as public opinion in these days has been graciously pleased to smile more upon scientific pursuits, instead of stigmatising their possessor as a "bug-hunter," or a "feller who is cracked about birds' eggs." How many English officers abroad would have found a taste for natural history—if they had only had it—a perfect godsend to them, and a satisfying of a want which billiards, and polo, and "pegs," and parades do not adequately fill!

And apart from this philanthropic view of the case, it is impossible to calculate the value to science of the labours even of the mere collector, in the shape of duly authenticated and localised specimens. And more than this, how many more opportunities might we ourselves, who, from the force of circumstances, are unable to pursue our studies in any distant part of the world, have made for ourselves for doing a little original work, if we had utilised our friends abroad more—if we had inspired them with the taste, and extracted from them a promise to look out for birds, or plants, or

insects, or fossils (according to what we are mainly interested in), and prepared them for the species which would be most likely to repay collecting, and the sort of places where they were most likely to be found. I think that an arrangement of this description would strongly resemble Shakespeare's description of the "quality of mercy," in this respect, "that it would be twice blessed—it blesses him that gives and him that takes."

I am inclined to regard it as a somewhat unpromising sign of the times, that so many manuals on the British Fauna and Flora are being issued at present. No doubt they have a use—and a very important use, though a limited one—they are of the greatest assistance to the beginners. In the hands of young students a reliable manual of the British representatives of the study of his choice forms a very desirable framework on which to base his future investigations. But with how large a number of persons is not the extent of scientific knowledge (if it can be called such) as comprised in a British manual their be-all, and end-all? Surely this is an unsatisfactory state of things. We all want a general knowledge as a foundation, but, that once gained, our next object surely should be, to become a specialist. In other words, as we are not, most of us, professional scientific men, and perhaps unfitted therefore to become leading lights in any one entire branch of natural history, we should try nevertheless to master completely some minor section of one branch of science, so as to benefit that science, as a whole, by our contributions to the knowledge of one of its parts.

I do not think that we amateur naturalists keep a sufficiently lofty ideal before our minds. It is well to derive amusement and recreation from our scientific pursuits, but should we not look higher than this? Science will, perhaps, put nothing in our pockets, but what of that? Is nothing worthy of real work which will not return so much per cent.? I think we should aim at being of use to our science in our degree—aim at adding our quota, though it be a humble one, to the general sum of knowledge, as far as our other avocations permit—to be, in short, scientific worker bees, not merely drones. And it is a question for ourselves to settle whether we are ever likely to do anything worth the doing, except by the merest chance, by going over and over again the same beggarly elements, where so many others have been before us, with the sole aid of never so excellent a British manual.

I am not sure that another feature of the scientific literature of the day, the large and increasing number of

county manuals—of birds, &c.—does not partly point in the same direction. I am referring chiefly to local ornithological manuals. These are mostly written—though there are notable exceptions—by ornithologists of mark, and with great ability, and are valuable contributions to knowledge, as far as they go. They are also, with the exceptions I have alluded to, an element which no writer on general ornithology would dream of disregarding, but from which he would receive valuable hints on the question of distribution. But writers on general ornithology are not numerous—and the copies which are published are—and where do they all go to? Whose hands do they fall into? Into the hands of those, I am afraid, to a great extent, who are either resident in the county or personally interested in it, and who want to know, or who think they ought to know, a little of the local birds—but not much—and who see in a county manual, and in the artificial boundaries of the county itself, a convenient dividing line between the amount of knowledge which it is worth while contemplating the distant acquisition of, and the wider field of general ornithological study, in which they have no ambition to be explorers, and which they mean to disregard.

And speaking of ornithology, I am afraid that it is partly made, owing to its present popularity, a kind of literary stalking-horse, a sort of peg to hang another sort of literary ventures on. In some of the magazines and periodicals which are devoted to light articles on general literature, and occasionally in the daily papers, there are occasional articles on natural history subjects (or, at all events, taking a natural history text), many of which would never, perhaps, have been written but for the popularity of the late Mr. Richard Jefferies, the able author of "The Gamekeeper at Home," and a number of like works. But the magazine articles of which I am speaking are written without the close observation of the gentleman I have named, and they mostly select what may be termed the romantic side of natural history, and it is doubtful whether they are of real benefit to any but the writer. They are little else than specimens of the prevalent disease (shall I call it?) of fine writing, of which the modern novel is the chief seat, and it is in the last degree unfortunate that natural history subjects should be selected as the theatre for such displays. "It is magnificent," a foreign gentlemen of some celebrity said of the charge of Balaklava, "but it is not war." In the same way, we may say of these articles, and of the books into which they occasionally expand, "they are all very pretty, but they are not natural

history." Reverent students of nature as she is will only be grieved to see sentimentalism imported into their favourite study.

We naturalists have another foe, who similarly desires to pass himself off under the guise of a brother, when he is nothing of the sort. I allude to the person who is a collector, and a collector only—not a student of nature—not one whose aim it is to make his collection when made an only more accurate book to read. I am not now speaking of the dealer, who is earning his living by the collection of specimens to be resold to those who require them. There are, however, dealers and dealers. But it is not of dealers that I am speaking—some of whom I desire to mention with all respect—but of amateur collectors. A great deal of the disfavour with which ornithologists are looked upon is brought upon them by amateur sportsmen and collectors. From these the ornithologist gets a reputation for ruthlessness, which I am convinced, from a pretty extensive acquaintance with him and his ways, he by no means deserves in the main. The naturalist proper, though ready to take life if the doing so will advance what he justly considers his lawful aim, is no less humane than ordinary mortality—indeed, if any thing, more so. He conceives himself entitled, on the highest authority, to take life for a definite purpose, and his, he considers, is a high one, but he won't tread on a worm or a beetle, or flatten a spider, because he considers it to be ugly, as many will. I have been often enough in the company of gentlemen whose title to be ranked as ornithologists is beyond question, and for weeks at a time, whilst they were, as one might say, on the war-path, and though they had guns constantly in their hands, they have made very little use of them; but, on the other hand, a very great deal of use of their field glasses. Anything that was killed, was killed because it was wanted to fill up a gap in their collection of reference, and was invariably utilised. At the very same time I have heard and seen the amateur sportsman cannonading away like an animated Gatling gun, slaughtering the beautiful and harmless gulls and sea swallows by the dozen—and, indeed, anything else that would let him get near enough. They were of no use to him when he got them, especially in such numbers; indeed, these gentry rarely take the trouble to pick up what they kill, much less to be humane enough to put the wounded and maimed out of their sufferings. I have seen myself the seashore almost strewed with dead sea swallows, the day after these brutes had been about, the taking of whose lives answered no purpose whatever, and

never was meant to. But if one of these creatures does take the trouble to carry home one or two of the least soiled of his victims, and has them stuffed (as the expression is) to ornament (as it is called) his house, he arrogates to himself the title of naturalist, and no one seems to dispute his right to it.

(To be continued.)

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(Continued from page 228.)

From the fault last referred to the Coal Measures occur at the surface to a little east of Burton, where they are lost sight of under the mantle of New Red Rocks which surround the Leicestershire Coalfield. These Coal Measures, as far west as we can trace them, have also been affected by the great earth movements which brought about the Charnwood axis of elevation, and show a system of faults and folds approximately parallel with this. They have also been subjected to plications and faulting at right angles to this axis, with the result that the strata of the western or more productive parts of the Coalfield have been thrown into a basin-like form, which has much conduced to their preservation. And here, perhaps, in dwelling upon this, it will be well to correct a misapprehension which has probably arisen in the minds of some of you, that elevated tracts of land are generally coincident with upward folds or ridges in the underlying rocks, whilst the valleys run in the troughs. This is undoubtedly sometimes the case, and we have seen two good instances of it in the structure of the Pennine and the Charnwood Ranges; but more frequently the very reverse holds good. When a mass of strata which has been thrown into a series of folds is planed down on its upper surface by the action of the sea, forming what is called a plain of marine denudation, it is evident that the folds which are convex upwards must be planed off before the concave portions or the troughs can be reached. Moreover, when such a plain of marine denudation becomes again dry land, and subjected to atmospheric influences, the trough and saucer-like portions of the folds, owing to the inclination of the strata towards each

other, will be more stable than the convex portions in which the strata incline outwards. In one case the force of gravity will *retard* denudation, in the other it will *facilitate* it. And thus it may, and often does come to pass that the summit of a hill is coincident with the trough of one of the folds, or the synclinal as it is called, whilst the valley runs along the anticlinal. Another reason for the difference is to be found in the frequent fracture of the tops of anticlinals allowing the freer access of water, and thus hastening the destruction of the arch.

It now becomes easier to understand what I have said about the saucer-like shape of the western portion of our Coalfield conducing to its preservation. This is a structure common to nearly all our Coalfields, and is merely a geological instance as applied to strata of the "survival of the fittest" to withstand denudation.*

Having now briefly glanced at the physical features and geological structure of the Pennine Range and of its southern extension under the newer rocks of the Central Midlands, we must try to ascertain something about the conditions under which the sediments forming the various portions of this huge pile of Carboniferous Rocks were originally deposited. But before we attempt to do this let us turn for a moment to what is going on at the present day around our coasts, and see if we cannot deduce from our observations some guiding principles with regard to the phenomena of sedimentation, which may help us in our enquiry.

We find that the material which is constantly being brought down by streams and rivers, and which has of course been derived from the degradation and waste of the land, is deposited on the bottom of the sea when the velocity of the currents bringing it down has been sufficiently checked. The particles thus carried down to the ocean vary in size from large rounded pebbles to the finest possible mud; and, since

* I do not know any better instance of the comparative stability of synclinally curved strata over strata curved in the opposite direction than is shown in a portion of our coast which most of you know well. The great Orme's Head at Llandudno is a bold hill of massive Mountain Limestone connected with a smaller hill of the same rock, the Little Orme, by a very narrow neck of low-lying ground. When the two hills are seen from Llanfairfechan on the west, it can be clearly seen that the strata of the Great Orme are bent upwards in a synclinal or saucer-like form, and it is perfectly evident from the lines of the curved strata that they once bent over again in the form of an arch to the mainland, and joined those of the Little Orme. The result of denuding forces acting equally upon this once continuous mass, has been entirely to remove the comparatively weak arch or anticlinal portion, and to leave the saucer-like synclinal untouched.

the carrying power of water is dependent upon its velocity, it is not surprising that we find a sorting action going on; that whilst the coarser sediment is deposited near the coast the finer material, under the combined influence of the outflow of rivers, and wave and tidal action of the sea, is carried out to a far greater distance from land before it is deposited on the more or less shelving bottom.

If we could make a horizontal section at right angles to the shore line of any large body of water, fed by running streams, we should find, as a general rule, a belt of coarse, roughly stratified shingle, giving place gradually to a less coarse and more sandy sediment, and this again graduating further from shore into beds of fine mud, which may extend for a very considerable distance. From the somewhat intermittent character of the streams and currents we should not expect anything like a sharp or invariable line dividing off these various sediments horizontally, but we should observe them dove-tailing, as it were, into each other laterally.

It is evident that the beds of fine mud forming the very outermost fringe of the land must come to an end somewhere, for, given a sufficient time, the very finest sediment will fall to the bottom.

As a rule, except in shallow seas and opposite the mouths of great rivers, the very finest mud deposits do not extend more than 100 miles from land. Farther out than this in deep water soundings have shown the bottom to consist of a widely spread deposit of a white sticky *ooze*, which, when dried resembles chalk in appearance and also in composition.* This is a veritable *limestone* now in course of deposition, and is the product of minute specks of living jelly, which abstract the carbonate of lime from sea water wherewith to form their shells, which, after the organisms are dead, are showered down upon the sea bottom. These microscopically minute animals are known as Foraminifera, and many of the limestones known to geologists have been built up almost entirely by their agency. They are, however, by no means the only limestone builders. Coral Polyps play a most important part in the production of modern limestones, and that they have played as important a part as far back as Devonian and Carboniferous times is equally certain. Then again we find some limestones made up almost entirely of the remains of Encrinites or sea-lilies, and of the shells of molluscs. Muddy water is absolutely inimical to the life and growth of these limestone builders, and we may be quite sure when we

* In the abyssal depths of the ocean this calcareous ooze is replaced by a red clay, the origin of which is at present unknown.

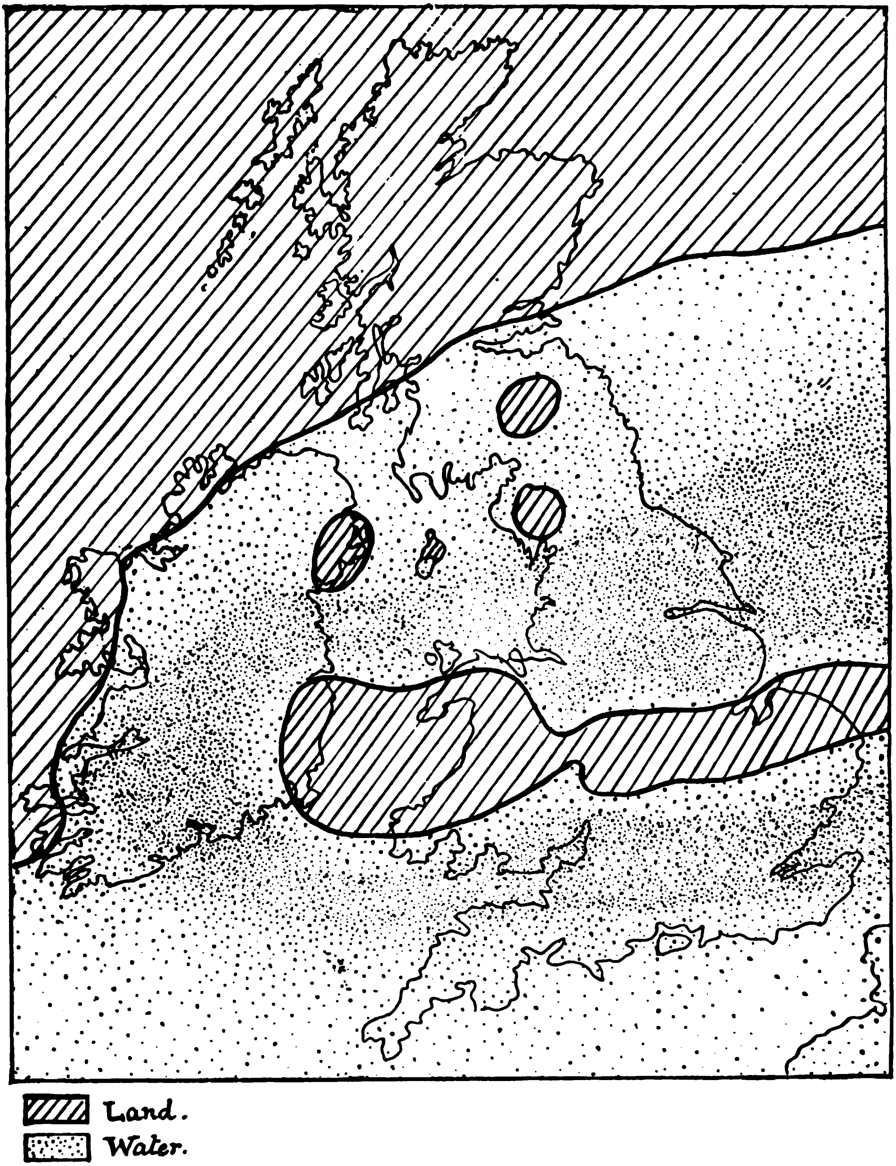
find a mass of pure or almost pure limestone of organic origin that the deposit was formed far away from land, or at any rate in water absolutely free from the influence of streams bearing their freight of mud seawards.

Such a mass of limestone is that of Central and North Derbyshire, and we are justified consequently in taking the first step in our reconstruction of the physical features of the Lower Carboniferous period, by assuming that this immensely thick mass of almost pure limestone marks the position of an area of deep and perfectly clear water.

When this mass of limestone of the Pennine Range is traced along the country to the north, we lose sight of it in the neighbourhood of Castleton, owing to its disappearance below the Yoredale Shales and Millstone Grit. When it is once more brought to the surface in the neighbourhood of Skipton, in Yorkshire, by the east and west plications already referred to, it shows some decided indications of altering its character, for we now find it containing several beds of shale, or hardened clay. Still, however, the limestone predominates, but the deposit has not quite the pure character of the limestone further south. A little further north still the shales or clays become thicker, and the limestones thinner, and, at the same time, the beds of limestone become divided by beds of *sandstone*. This progressive change continues right into Northumberland, where the massive Mountain Limestone and Yoredale Series of Derbyshire are found to be replaced by a mass of sandstones, shales, and thin limestones, containing in the upper part as many as seventeen seams of thin, but workable coal, all deposits of shallow water origin.

Now this extraordinary but gradually progressive change in the character of the beds when traced laterally, can only be satisfactorily explained in one way, when we bear in mind what we may call the physics of sedimentation. As we proceed northwards, we are leaving behind us the deep sea of Lower Carboniferous times, with its clear water and limestone-building creatures, and are approaching, through gradually shoaling water, *the old coast line, and the mouths of the rivers which brought down from the old Carboniferous land the sand and mud which now form the sedimentary deposits.*

The exact position of this old coast line is indicated by a bed which lies at the very base of the Carboniferous rocks of the North of England, but which is, of course, not met with in the Midlands. It is what is known as a Conglomerate, a rock-like mixture of sand and rounded pebbles. It is, in fact, a consolidated and fossilised sea-beach, and we find it abutting against the old shore formed by the Cheviot Hills, from which most of its rolled fragments have been derived.



MAP OF THE AREA, NOW OCCUPIED BY BRITISH ISLES, DURING THE LOWER CARBONIFEROUS PERIOD.

N.B.—The relative depth of the water is indicated by the dotted shading.

Although the Cheviots formed land during early Carboniferous times, we have sufficient evidence to indicate that the area was an *island*, and that we have to look still a little further North for the coast of that great continent which was drained by the rivers of the Carboniferous period. In Lanarkshire we find the old Carboniferous beach resting upon the old Red Sandstone, and, to a great extent, derived from its waste. From the thinning out of all the beds above this, there is the strongest possible evidence that, across a line drawn from the Firth of Tay to the extreme North of the Island of Arran, the shore conditions continued for a very long period in Lower Carboniferous times, and that the land rose rapidly North of this line, in the region of the Scotch Highlands, to a much greater height than it does at the present time.

In Ireland the Carboniferous Limestone is strongly represented in Clare, Tipperary, and Queen's County, its greatest development being only about half a degree of latitude further south than its greatest development in our own Northern Midlands. Here, just as with us, the limestone shows the same tendency to give place to mechanically formed deposits, *i.e.*, sandstones and shales, further towards the north and north-west, indicating, as with us, the direction in which the old land lay. That the western portions of Donegal, and of Connaught, formed part of this coast there is a great deal of evidence to show, and it is probable that the western portion of County Kerry was also above water.

Around the old Silurian Rocks of our Lake District there are found thick uneven deposits of Conglomerate and Sandstone, belonging to the base of the Carboniferous, and, from their irregularity and the rapid way they thin out, it is evident that they were beach deposits banked around an island in the Carboniferous Sea. There are also similar deposits in the southern part of the Isle of Man.

Having traced the Mountain Limestone of the deep water of Central Derbyshire to the north and north-west shore of the sea in which it was deposited, we will retrace our steps once more to the Derbyshire district, and ascertain what becomes of this massive limestone when followed southwards.

The southern prolongation of the limestone of the Weaver Hills plunges, as we have seen, beneath the more recent New Red Measures, near Ashbourne, and we see nothing more of it until, owing to a series of small folds, it is brought to the surface again some 20 miles to the south-east on the northern margin of Charnwood Forest. We there find it in eight small patches, of which that of Ticknall is the most northerly, and that of Grace Dieu the most southerly.

(To be continued.)

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Continued from page 235.)

In India the product of the bark is used mainly in the form of a mixed febrifuge in which the different alkaloids are not separated from one another. This is prepared from the finely-powdered bark by mixing it with milk of lime and spirits of wine. At the close of 1882 there were in the Bengal plantations a stock of nearly five millions of trees, of which three-quarters were *C. succirubra*, yielding an annual crop of 400,000 lbs. of dry bark. The amount of capital altogether expended in Bengal in the plantations and manufactory was £100,000, and on this the receipts for 1878-9 yielded 4¼ per cent. on the capital outlay, exclusive of 5,500 lbs. of the alkaloid taken for the Government hospitals, which replaced an equal amount of quinine, which, if purchased, would have cost the Government £44,000. Dr. King estimates that by the end of 1878-9 the total amount saved to Government was £80,000, and Mr. Wood, the Government quinologist, estimates that the cost of the mixed febrifuge will ultimately be brought down to a shilling per ounce. The price of the sulphate of quinine in England has been reduced during the last few years from 18s. to 5s. per ounce. As before explained, only four out of the thirty-six species have been extensively planted in India, and of the economic value of many of the others very little is known clearly.

India-rubber.—What is sold under the name of india-rubber is the stiffened milky juice of at least six different genera of trees, belonging to three widely different natural orders, *Landolphia* and *Willughbeia* in *Apocynaceæ*, *Castilloa* and *Ficus* in *Artocarpeæ*, and *Hevea* and *Manihot* in *Euphorbiaceæ*. Part of it comes from South America (shipped principally from Para and Carthagena), part of it from Sierra Leone, Mozambique and Madagascar, and the remainder from tropical Asia. Besides these two genera of Apocynaceæ, there are at least six others which yield a similar milky juice, which is not at present utilised to any considerable extent. In the United States in 1883 there were 120 india-rubber factories, employing 15,000 hands. The total importation of raw material into the States in that year was

80,000 tons, worth about six million pounds sterling. The value of the manufactured goods made in a single year is estimated at fifty million pounds sterling. The quantity of unworked rubber imported into the United Kingdom in 1888 was over 10,000 tons, worth about £8,500,000; but in 1885 it had sunk to less than £2,000,000.

None of the trees which yield india-rubber have yet been brought into cultivation on a large scale, and the time will soon come when either this will have to be done, or the supply will gradually lessen. There are about sixty distinct species in these rubber-yielding genera,* and the botanists and foresters will have to settle between them which of these are best worth cultivating, and where it will pay to grow them. Unfortunately at the present time the price of india-rubber of all kinds is exceptionally low, the best Para rubber being now only worth about 2s. 6d. per lb. in London, against 4s. in 1884, and the best of the African and Asiatic kinds about 2s. per lb.

* *List of the india-rubber producing genera, their native countries, with the number of species in each, and annual import:—*

Order.	Genus.	Number of Species.	Native Country.	Quantity Imported into England in 1880, in tons.
Apocynaceæ	Willughbeia ..	9	Tropical Asia ..	530
Do.	Landolphia, including Vahea	16	Africa and Madagascar	2,200
Do.	Hancornia ..	1	Brazil	
Do.	Urceola	7	Malay Peninsula and Archipelago	
Do.	Dyera	3	Malay Peninsula	
Do.	Couma (Collophora)	4	Guiana and Brazil	
Do.	Alstonia	3	Malaya and Fiji	
Do.	Cameraria ..	2	West Indies ..	
Artocarpeæ	Castilloa	3	Central America and Cuba ..	100
Do.	†Ficus	2	Africa and Tropical Asia ..	370
Euphorbiaceæ	Hevea	9	Amazon Region	3,768
Do.	Manihot	1	Brazil	35
		60		7,003

† There are altogether over 400 species of Ficus, but only two yield india-rubber.

Gutta-percha of the best quality is the product of *Dichopsis Gutta*, a tree belonging to the natural order Sapotaceæ, inhabiting the Malayan peninsula. In order to obtain it the Malays follow the wasteful and extravagant plan of cutting down the tree. The bark is first stripped off, and the milky juice which then exudes is collected in the shell of a cocoa-nut or the spathe of a palm. The juice quickly stiffens on exposure to the air, and forms gutta-percha. The average quantity obtained from one tree is 20lbs. In 1875 ten millions of pounds in weight were imported into this country from Singapore, and this would involve the destruction of 50,000 trees.

It was first brought into notice in 1842, and at that time the tree was plentiful in the forests of the island of Singapore, but during the next five or six years it was totally destroyed on the island, except a few trees that were kept as curiosities. In 1847 it was plentiful in the forests of Penang, but a similar fate soon befell it there, and now the time has come when, unless it be systematically cultivated somewhere, the supply will decrease. According to the latest authority, there are six distinct species of *Dichopsis* growing wild in the Malayan peninsula, and in Java and Sumatra, and several species of the neighbouring genera, *Chrysophyllum*, *Sideroxylon*, *Bassia*, *Mimusops*, *Payena*, and *Imbricaria*, yield a similar milky juice; but it still remains to be settled which species are best worth cultivating, and where they can be most profitably grown. The annual value of the gutta-percha imported into England is between £300,000 and £500,000 per annum.

Timber Supply.

The burning question of forest destruction and our future timber supply it is impossible to deal with at all adequately in the time I have at command. Of the importance of the matter from a financial and economic point of view an idea may be formed from the admirable series of statistics got together by Professor Sargeant for the last census report of the United States. He estimates the annual value of the produce of the woods of the United States at 490 millions of dollars, or £100,000,000, the number of hands employed in the timber trade of the States at 148,000, their annual wages at 32,000,000 dols., and the number of persons in the States who are entirely dependent on wool as fuel at 32,000,000.

The following extract, which refers to the island of Jamaica, will give an idea of the reckless and extravagant way in which the natural forests have been destroyed in some of our colonies:—

"In certain localities hundreds of thousands of acres have been converted into desert by the wholesale destruction of the forest. In other localities hundreds of thousands of acres would from the same cause now be utterly unproductive but for the planting of foreign trees, such as Logwood and Mango. In consequence of the facility with which land is everywhere available in Jamaica, the peasantry cut down annually 40,000 acres of forest land and thick bush, in which to plant yams and other provisions. Innumerable timber trees, young and old, are thus yearly destroyed. These clearances are made in the most seasonable districts, and in many instances the excessive rainfall in such districts is perceptibly diminished in consequence of the large extent of these clearances. No conservation of the forest having ever been attempted here, the result is, as regards timber, that the resources of the island are practically *nil*. There is indeed some timber in the inaccessible hills of the interior.

"Nearly all the timber required for building purposes, the annual value of which amounts to about £50,000, is imported into the island. Even the sleepers lately used for laying down the few miles of tramway in and near Kingston were imported. The unproductiveness of the island in timber is to be further deplored when our luxuriant tropical resources are borne in mind, and also when it is remembered that only one-thirtieth of the island is devoted to agriculture. In the event of any considerable advancement in the prosperity of the island a very large expenditure would be entailed for the importation of timber."—*Thomson, in Kew Report, 1877, p. 43.*

(To be continued.)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 181.)

Sub-genus VII.—Mycena.

108. **Ag. purus,** *Pers.* *Ag. roseus*, With., Purt. Woods and plantations. Sept.-Oct. Plantations, Edgbaston, *With.*, 258. Oversley Lane, *Purt.*, ii., 648. Oversley Wood; Ragley Wood, *Purt.*, iii., 224. Kenilworth, Sep., 1849, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.* Marston Green; Trickley Coppice; New Park Middleton; in a copse at Kenilworth.

104. **Ag. pseudo-purus**, *Cooke.* Woods. Oct. Edgbaston Park; Bradnock's Hayes; Trickley Coppice and New Park, Middleton.

Probably a variety of the preceding.

105. **Ag. luteo-albus**, *Bolt.* Woods. Oct. The Spring, Kenilworth, *Russell, Illustr.*

106. **Ag. flavo-albus**, *Fr.* Amongst moss. Oct. The Common, Kenilworth, *Russell, Illustr.* Shilton, near Coventry, *Adams.* Upper Nut-Hurst, Sutton Park, *Dr. Cooke.*

107. **Ag. rugosus**, *Fr.* Roadsides. Rare. Aug. Marston Green; Packington Park.

108. **Ag. galericulatus**, *Scop.* *Ag. varius*, With., Purt. On stumps and trunks of trees. Sept.-Nov. Edgbaston, *With.*, 287–8. Crackley Wood; Burton Green Wood; willow stumps, Birmingham Road, Kenilworth, *Russell, Illustr.* Warwick, *Perceval.* Combe, *Adams.* Longford, *Rugby Sch. Rep.* Sutton Park; New Park; Stechford; Olton; Marston Green; Shawberry Wood; Water Orton; Kinwalsey; Sharman's Cross, Solihull; Knowle; Corley, etc.

Var. *calopus*, Fr., New Park, Middleton.

109. **Ag. polygrammus**, *Bull.* Stumps of trees. Oct. "The variety *polygrammus* was brought to me by my friend Mr. Rufford," *Purt.*, iii., 278; exact locality doubtful. Kenilworth, variety with smooth stem, *Russell, Illustr.* Combe, *Adams.* Wood near Wolvey; Coleshill Heath.

110. **Ag. pullatus**, *Berk.* and *Cooke.* On the ground amongst dead leaves. Sept.-Nov. Rare. Cooke, Illustr., t. 257. New Park; pine wood, Coleshill Heath; Coleshill Pool; Water's Wood, Maxtoke.

111. **Ag. pauperculus**, *Berke.* Oak stumps. Rare. Oct. Oak stump, Kenilworth, *Russell, Illustr.*

112. **Ag leptocephalus**, *Pers.* Very rare. Pine wood above Coleshill Pool.

113. **Ag. alcalinus**, *Fr.* On trunks of trees. Aug.-Nov. Warwick, *Perceval.* Kenilworth, *Russell, Illustr.* Binley, near Coventry, *Adams.* Sutton Park; Langley; Castle Bromwich; Water Orton; Shawberry Wood, Shustoke; Water's Wood, Maxtoke.

114. **Ag. ammoniacus**, *Fr.* On the ground amongst grass, overlooked. Marston Green; New Park, Middleton; Corley Woods. We fear this has often been overlooked through confusion with *Ag. alcalinus.* It grows singly, not cæspitose, and chiefly on grassy roadsides.

115. **Ag. metatus**, *Fr.* Amongst moss in woods. Oct. Amongst leaves and moss, New Park, Middleton, named by Mr. C. B. Plowright.

116. **Ag. stanneus**, *Fr.* Amongst grass, in woods. Rare. Oct. Coleshill Pool; Bradnock's Hayes.

117. **Ag. vitreus**, *Fr.* Woods. Rare. Sept. Water's Wood, Maxtoke ? (1882).

118. **Ag. tenuis**, *Bolt.* Moist woods. Rare. Sept.-Oct. Burton Green Wood, Kenilworth, *Russell, Illustr.* Pine wood, Coleshill Heath, on sphagnum; Haywood, on sphagnum.

119. **Ag. filopes**, *Bull.* *Ag. varius*, var. 8, With. Amongst leaves in woods. Sept.-Oct. Edgbaston Park, *With.*, 287. Combe Woods, *Adams.* Sutton Park; New Park, Middleton.

Withering's plant can scarcely be this species.

120. **Ag. amictus**, *Fr.* Rare. Oct. Among fern roots, etc., under a glass shade, in the house, Birmingham; Cooke, Illustr., t. 286.

121. **Ag. vitilis**, *Fr.* In woody places, among grass. Not common. Bradnock's Marsh; Olton Reservoir; Sutton Park.

122. **Ag. acicula**, *Schæff.* On sticks. Sept.-Oct. Hopsford, *Adams.* Driffold Lane, Sutton; New Park, Middleton.

123. **Ag. sanguinolentus**, *A.* and *S.* Amongst leaves in woods. Oct. Not uncommon. Sutton Park; Four Oaks; Trickley Coppice; Hams Hall; Marston Green.

124. **Ag. galopus**, *Pers.* Amongst leaves. Frequent. Sept.-Nov. Red Lane; Crackley Wood! Clarendon Villa, Kenilworth, *Russell, Illustr.* High Wood, Combe, *Adams.* Edgbaston Park; Sutton Park; New Park; Trickley Coppice; Coleshill Pool; Water Orton; Iron Stone Wood, Oldbury; Olton Reservoir; Solihull; Haywoods, etc.

Var. *candidus*, all pure white milk, abundant. See "Journal of Botany," xxii., 129. At Four Oaks.

125. **Ag. leucogalus**, *Cke.* Very rare. New Park, Middleton, on the ground, Oct. 7th, 1883. Cooke, Illustr., t. 658, was not published at that time, but it represents the New Park species very closely; the description agrees exactly, except in the habitat. "I have just now (Sept., 1888) re-discovered this species at Langley; this time I observed it was attached to a fragment of wood in the soil."—W. B. G.

126. **Ag. epipterygius,** *Scop.* Amongst dead leaves. Oct. On the mossy bark of a tree, Kenilworth, *Russell, Illustr.* Combe Woods, *Adams.* Sutton Park; Trickley Coppice; New Park; Maxtoke; Brown's Wood, Solihull; Marston Green; Bradnock's Hayes.

127. **Ag. vulgaris,** *Pers.* Woods. Rare. Combe Woods, *Adams.* School Rough, Marston Green.

128. **Ag. tenerrimus,** *Berk.* Fir cones and twigs. Rare. Kenilworth, *Russell, List.* Greenhouse at Lady Adams', Ansty, *Adams.* Sutton, on dead bark; Four Oaks.

129. **Ag. electicus,** *Buckn.* Very rare. Oct. Sutton Park; Olton Reservoir; in both places on dead and rotting rush stems.

130. **Ag. corticola,** *Schum.* *Ag. corticalis,* Purt. On dead branches of bramble, &c. Rare. Oct. Ragley Wood; Oversley Wood, *Purt.*, iii., 214. Clarendon Villa, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow. *Adams.* Sutton; Olton Reservoir. *Merulius fœtidus,* Purt., ii., 620, from his garden at Alcester, is, *teste ipso,* a form of this; see iii., 391.

Sub-genus VIII.—Omphalia.

[**Ag. pyxidatus,** *Bull.* Occurred among grass by the roadside, California, Harborne, Worcestershire.]

131. **Ag. sphagnicola,** *Berk.* On sphagnum. Rare. May-June. Bog above Blackroot Pool, Sutton Park, *Dr. Cooke,* 1883.

132. **Ag. hepaticus,** *Batsch.* Grassy places. Rare. Oct. Kenilworth, *Russell, Illustr.* By the railway above Blackroot Pool, *Dr. Cooke,* 1883.

133. **Ag. muralis,** *Sow.* Walls, &c. Rare. On a wall amongst moss, Edgbaston.

134. **Ag. umbelliferus,** *Linn.* Heaths. Sept.-Oct. Sutton Park; New Oscott.

Var. *myochrous,* Fr. *Hym. Eur.*, p. 161. *Merulius fuscus,* With., 147—"Packington Park, in clusters,"—is referred by Fries to this variety. The gills are described as subdichotomous, and the colour of the whole as fuscous umber.

135. **Ag. pseudo-androsaceus.** *Bull.* Heaths. Rare. On the top of an old wall at Wixford, Oct 15, 1820, *Purt.*, iii., 185. It is likely that Purton's plant was rather a form of the preceding species.

136. **Ag. stellatus,** *Fr.* *Merulius buccinalis,* With., Purt. Amongst grass, on rotten wood. Rare. Feb.-Oct. Packington Park? *With.*, 146. Ragley Woods, *Purt.*, iii., 180. Olton Reservoir, Oct., 1881. This species is very doubtful, although the specimen from Olton certainly seemed to agree with the description.

137. **Ag. campanella,** *Batsch.* *Ag. fragilis,* With? Woods. Rare. Pool dam, Edgbaston? *With.*, 207. Withering quotes "Schæff, 230," which is this species, but the description of the stem does not agree, although that of the pileus and gills is fairly correct.

138. **Ag. fibula,** *Bull.* In mossy ground. Not uncommon. Sept.-Nov. Packington Park, amongst moss! *With.*, 178. Oversley Hill, *Purt.*, ii., 641. Edgbaston Park; Windley Pool; Sutton Park; Alveston Pastures. *Ag. parvus,* With., 238, "pastures, Edgbaston, amongst short grass and moss," is doubtless the same species, although he quotes Bulliard's figure of *Ag. hiemalis,* Osb., with which his description does not agree.

139. **Ag. integrellus,** *Pers.* On decaying sticks, in damp places. Rare. May-Dec. Maney, near Sutton Coldfield; School Rough, Marston Green.

Sub-genus IX.—Pleurotus.

140. **Ag. corticatus,** *Fr.* On decaying wood. Rare. Oct. Driffold Lane, Sutton.

141. **Ag. dryinus,** *Pers.* On trunks of trees. Rare. Oct. Ansty, *Adams.*

142. **Ag. ulmarius,** *Bull.* On elm trunks. Local. Sept.-Dec. On the branch of an elm, Kenilworth, *Russell, Illustr.* Driffold Lane, Sutton; Sutton Park; on a felled elm tree, near Solihull Railway Station.

143. **Ag. subpalmatus,** *Fr.* *Ag. palmatus,* Purt. On squared timber. Rather rare. Oct. On the trunk of a tree crossing the moat at Studley Castle, *Purt.*, ii., 656; Pophills, *Rufford*; at the bottom of a stump, Oversley, *Purt.*, iii., 430; Warwick, *Perceval*; Coventry Road, near Kenilworth, 1850; smooth variety, Kenilworth, *Russell, Illustr.*; Withybrook Lane, near Brinklow, *Adams.*

144. **Ag. craspedius.** *Fr.* On wood. Rare. Oct. A large cluster in a cellar, St. Vincent Street, Birmingham; *Saund and Smith*, t. 7.

145. **Ag. fimbriatus,** *Bolt.* Rare. There can be little doubt that Withering's *Ag. infundibuliformis*, var. 2, "Bolt., 61," is truly this species; "in the Park at Packington," *With.*, 154. [Clusters of it have been found on old logs in a garden at Handsworth, Staffordshire.]

146. **Ag. ostreatus,** *Jacq.* On stumps and logs. Rather rare. Esculent. Nov.-Jan. Edgbaston Park, *With.*, 294; near Studley Castle; Oversley Mill, *Purt.*, ii., 655; Kenilworth, *Russell, List.*; Driffold Lane and Sutton Park; Legge Lane, Birmingham.

147. **Ag. enosmus,** *Berk.* On stumps. Rare. Sept. Elm, by Red Lane, Kenilworth, *Russell, Illustr.*

148. **Ag. salignus,** *Fr.* On trunks of trees. Rare. Oct. On a stump, near Warwick, *Perceval.*

149. **Ag. petaloides,** *Bull.*, var. β, *Spathulatus*, Pers. *Ag. spathulatus*, Purt. On the ground. Rare. Oct. Oversley and other places in this neighbourhood, *Purt.*, ii., 656; cf. iii., 287, 481.

150. **Ag. acerosus,** *Fr.* Very rare. Dunspits Lane, Kenilworth, *Russell, Illustr.*

151. **Ag. applicatus,** *Batsch.* On rotten wood. Oct. Rosal Lane (Rose Hall Lane), Oversley, *Purt.*, ii., 659. Sutton Coldfield.

152. **Ag. chioneus,** *Pers.* On wood. Rare. Oct. Sutton Park, on fragments of bark.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 148.)

PART V.—THE MIDDLE LIAS CONSIDERED AS A RECEPTACLE FOR WATER, WHEREBY FLOODS MAY BE MITIGATED.

The last few years, in this country, have been comparatively dry ones, and on this account chiefly, I presume, very little has been heard of floods, or river conservancy, or drainage schemes. It is only a few years, however, since excessive and destructive floods were of frequent occurrence in the Midland districts, and there was considerable discussion as to their cause, and as to how they might be prevented. The very fact that such destructive floods have not occurred along the Nen valley recently, points conclusively to the main cause of such floods, viz., *excessive and unseasonable rainfall.*

The injurious effects of floods are not confined to agricultural districts, but the low-lying parts of many towns, Northampton included, are subject to inundation, when, besides the actual damage and interference to traffic thereby brought about, some illness is generally the result. I have several times seen the flood water up to the axle-trees of carts in the lower streets of Northampton, a condition of things it is very desirable to avert if possible. No doubt many towns were formerly built in the situations where we now find them, because of the advantages afforded by water communication with other places, and although this is of less consequence now, on account of railways, it is impossible to alter the situation of a town. Valleys are often selected for railways, for the double reason, probably, that most towns are situated in or near them, and they offer less obstacles to engineers, and are therefore less expensive. Railways so situated are liable to damage from floods.

The damage done by floods in agricultural districts is often of a serious nature; animals are drowned, hay and other farm produce is spoiled or even washed away, and the herbage of the fields so injured by the deposition of earthy and confervoid matter on it as to be practically valueless. Besides the more evident damage done in this way, greater and more lasting injury is incurred from the sodden condition of the meadow lands, sometimes for a good portion of the year, during which time they cannot be used for stock, and a coarse and innutritious herbage is gradually replacing the better kinds of grass.

Summer floods are much more injurious than those occurring in winter. The temporary and permanent injury to grass is greater; there are then crops to be destroyed or injured, and an outbreak of "rot" in sheep is exceedingly likely to follow. It is now well known from the researches of Mr. A. P. Thomas, of Oxford, that the aquatic snails, *Limnæus pereger*, and *Limnæus truncatulus*, are capable of acting as hosts to the liver-fluke (Fasciola Hepatica) during one stage of its career; and as these snails are likely to be spread over the fields by summer floods, when the moisture and temperature are both favourable to the development of the eggs of the fluke, an outbreak of "rot" is exceedingly likely to occur.

Floods are not an unmitigated evil. Providing they come at the right time, and the water does not stagnate, they may be of great benefit. A form of irrigation which cannot be controlled must of necessity do damage at times, but I doubt very much whether occupiers of the meadow lands along the

Nen valley would care to be entirely relieved of floods; they would prefer to have the water, if they could only have it at suitable times and get rid of it a little sooner, because of the fine silt which it brings, and which renders ordinary manuring unnecessary. Farmers are never likely to secure all these advantages, but some of them they might, providing they had somewhere to drain into; this the water scheme under consideration provides.

There are many causes tending to produce floods, and the relative amount of importance attached to any one of them is somewhat a matter of individual opinion. I have placed below the commonly-assigned reasons for recent heavy floods in the Midland counties in the order of their importance, according to my own belief:—

1.—Excessive Rainfall.
2.—Agricultural Drainage.
3.—Blocking-up of Streams.
4.—Artificial Obstructions, such as Mills, Railway Banks, Bridges, &c.

1.—Excessive Rainfall.—That the rainfall for a number of years previous to 1883 was excessive is, I take it, an incontrovertible fact. The wet period I refer to extended from 1872 to 1883, twelve years; and from particulars furnished me by Mr. F. Law, for Northampton, I find that the average rainfall for the last nineteen years, including, of course, the wet period, is almost exactly 25 inches, whereas the average for the wet period was 27½ inches, and the average of the dry period, that is three years previous to 1872 and four years since 1883, only 21 inches, showing a difference of 6½ inches between the wet and dry years. The lowest yearly average is for 1870 (16·19 in.), and the highest is for 1872 (33·15in.), a difference, it will be seen, of 16·96 inches. Three other years, 1875, 1880, 1882, gave averages nearly double of the minimum. It cannot be said that 33 inches is an excessive rainfall, except by comparison with drier years, and had the rain been more evenly distributed over the year very little damage would have resulted.

So far as my experience enables me to judge, I should say that it almost invariably happens that the excess of rain, above the average for the district, is due to heavy falls in a short period; and these are particularly liable to cause floods, for much of the water will run over the surface of the ground even in well drained districts, and the floods very rapidly follow the rain. These heavy falls not unfrequently occur in the summer time, during thunderstorms.

An increased rainfall in a district need not be a cause of floods, for, if it is not particularly heavy, a rain may continue a long time before any very perceptible effect is noticed, depending upon the previous condition of the ground. After a dry period two or three inches of rain may fall before there is sensible percolation, much less floods; the huge cracks in even badly drained soils receiving and distributing a great quantity of water through the dry earth. At other times less than an inch of rain may produce considerable floods.

In July, 1875, very extensive floods occurred in the Midland counties; part of Northampton was under water, and the Nen valley was like one vast lake. The rains which caused these floods had been preceded by heavy rains a few days previously; and so the ground was well saturated, and made incapable of receiving much more water.* Other floods occurred later in the year, and altogether, perhaps, floods were more extensive and destructive than in any other year since 1852.

On Thursday, April 16th, 1885, about 1·15 inches of rain (partly snow at first) fell in Northampton from mid-night to mid-day, and this fall produced heavy floods in the Nen valley the same day, and lasting over the Sunday following. This had not been preceded by any exceptional rainfall.

In May, 1886, no rain fell for the first nine days. On the 10th there was ·10 inches, on the 11th ·45 inches, and on the 12th 1·07 inches, in all 1·62 inches in three days, and heavy floods were out in the Nen valley on the 12th. Hence we see how small an amount of rain may produce floods when the predisposing circumstances have not been exceptional.

Of course floods almost invariably follow the melting of snow, for although percolation is most easy at such times, owing to the disintegration of the ground by frost, it is generally more or less saturated with water, and the amount of snow melted may be the accumulation of several separate snow-storms. It is not unusual for the thaw to be accompanied by rain, which still further increases the flood. To these causes may be added one other: if the snow fell after frost had set in, when the thaw comes much water will run off the surface and accumulate in the valleys before the ground has thawed sufficiently to let any in.

According to the best information I can get, it appears that when a fall of rain occurs sufficient to cause a flood in

* For much valuable information on these periods of heavy rainfall see "On the Floods in England and Wales during 1875, and on Water Economy," by Geo. J. Symons. Paper read before the Institution of Civil Engineers, 1876.

the Nen valley, such flood will follow within 24 hours, and generally in less time than this. It is not uncommon for a flood to be at its highest in 12 hours. In winter ½ inch of rain in 24 hours is sufficient to cause a flood, in summer time from 1 to 1½ inches in the same time, depending upon the previous condition of the land. Floods in winter time will often last for weeks together in the Nen valley, and the ground most subject to these floods be unfit for stock for quite half the year. They are regarded as half-yearly lands.

2.—Agricultural Drainage.—Although I have placed this second as an individual cause of floods, it must be regarded as quite subordinate to the one just considered, inasmuch as drainage is only intended to get rid of excess of water which, in most cases, has only a short time previously fallen as rain. I also wish it to be understood that I do not consider it equal to the aggregate of the other natural and artificial causes to be enumerated.

The advantages of land drainage in a country like England are so obvious that few words are required on this matter. It is very probable that, because of the considerable and evident benefits often derived from drainage, as with other good things, it has, in some cases, been imitative and indiscriminate, and therefore excessive.

There is no doubt it is much better for rain water to pass through the soil than simply over its surface, within certain limits as to quantity. In the latter case it will take much away, but not add anything itself, whereas in the former it will generally enrich rather than impoverish the land, so far as useful plant food is concerned. The rapid removal of water from the surface of ground is very desirable, both for the good of human beings and animals breathing the atmosphere above it, and for plants being grown in it. The temperature of well drained land is higher, and plant growth in consequence more rapid, and cultivation generally is a much easier and less precarious operation.

I know the opinion is held by some, that drainage has not been and cannot be carried to excess. It is asserted that undrained lands may suffer most in dry weather, for stagnant water in the early part of the year retards vegetation very much, and renders it more liable to damage from late frosts, both of which causes tend to produce a scanty herbage, or less luxuriant crop on arable land, and if the weather is hot and dry in May and June, they will both suffer more than if the crop had been more luxuriant and the ground better covered; that is, the productive capabilities of the soil are reduced to a minimum. If we accept this explanation, and

add to it the probability that there would be no lack of water during the summer, the case for extensive drainage seems very strong.

The average good from land drainage is vastly in excess of the evil, no doubt; but I cannot help sharing the belief that the scarcity of water in some water-bearing beds, and the calls for rain from farmers themselves, after an interval of dry weather, are partly due to extensive agricultural drainage, for whatever arrests percolating water reduces the springs from underlying porous beds, and whatever dries the soil reduces the interval between a shower and the time when another is required. I have several times traced drains in grass fields by the dry and withered condition of the herbage. I cannot think I should be far wrong in describing the drainage there as either indiscriminate, or excessive for that season, though perhaps only sufficient for others.

Taking Northamptonshire as a whole, I unreservedly accept the assurances of numerous farmers, several of them my personal friends, and all of them speaking with the authority of experience, that there is very little land over-drained in this county, but very much that requires draining.

(To be continued.)

Wayside Notes.

In the last number of the "Midland Naturalist" (p. 238), a specimen of *Cotula coronopifolia* was exhibited from Norway. It was then stated that it came from its only locality in Europe. This must be incorrect, since Nyman, in his Conspectus, gives it as occurring in Denmark, Germany, Holland, North Spain, and Portugal. Mr. C. Bailey has collected it in Cheshire, to which county (as probably to its European localities) it has been introduced. I saw it growing plentifully, and apparently native, in marshy ground between Cadiz and Algeciras, in 1887. G. C. Druce.

Russula claroflava sp. nov.—This species resembles *Russula ochroleuca*, and might by some be considered only a strongly-marked variety of that, but it differs in other points than colour so remarkably that it is, in my opinion, fairly entitled to be considered distinct. It has occurred for many years successively at Wyndley Pool, Sutton, and always presents the same appearance. In stature it approaches *R. citrina*, but resembles *R. ochroleuca* in the ultimately rugose and cinereous stem, which is at first white and smooth, but ultimately becomes even more darkly cinereous than in that species. The colour of the pileus is a pure rich chrome-yellow, even approaching the paler shades of egg-yellow, and the same tint is found occasionally on the base of the stem. The gills differ from both the species mentioned in becoming a pale lemon-yellow. The flesh, wherever wounded, becomes somewhat rufous. *R. claroflava*: pileus, 2-3 inch, convex, at first

bullate, then plane, slightly depressed in the centre, chrome-yellow; margin turned down, at length patent, perfectly even or slightly striate when old, often paler than the disc, but sometimes of a deeper colour; cuticle not so easily separable as in *ochroleuca*; flesh white, yellow beneath the cuticle; stem 1½-2½in. × ½-¾in., smooth, white, cylindrical, blunt at base, slightly spongy within, at length rugose and cinereous or even blackish; gills scarcely crowded, not reaching the stem so much as in *ochroleuca*, not united behind, white, then altogether pale-lemon yellow, at length sub-ochraceous. Amongst grass in damp places, Wyndley Pool, Sutton Coldfield. September-October.

W. B. GROVE, B.A.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION, August 28th, Mr. W. B. Grove, B.A., in the chair.—Mr. Bagnall exhibited *Cuscuta Europæa*, *Bupleurum rotundifolium*, *Arundo Epigejos*, *A. Calamagrostis* from Upton, Warwickshire; for Mr. Bolton King, *Rosa scabriuscula*, from Gaydon; for Miss Gingell, *Helleborus viridis*, fasciated form of *Verbascum nigrum*, *Epipactis latifolia*, *Solidago virga-aurea*, &c., from Dursley, Gloucestershire; and a specimen of dry rot, *Merulius lachrymans*, from a manufactory in Birmingham. Mr. C. J. Wainwright exhibited larvæ of *Selenia illustraria*, a case of mimicry of sticks. Mr. W. B. Grove exhibited *Vicia tetrasperma*, *Sison amomum*, and *Hypericum hirsutum*, from Spernal, and a number of Fungi, among which were *Cortinarius torvus*, *Ag. infundibuliformis* var. *membranaceus*, and *Nyctalis parasitica*, growing on old stems of *Russula nigricans*, and itself having *Hypomyces baryanus* parasitic upon its gills. Mr. J. Edmonds exhibited *Bovista nigrescens* and *Lycoperdon gemmatum* var. *furfuraceum*, from Pendinas Wood, Aberystwith. MICROSCOPICAL SECTION.—Meeting, Tuesday, September 4th, Mr. J. F. Greenway in the chair. Mr. Buncher was duly elected a member of the Society. Mr. T. E. Bolton exhibited *Chirocephalus diaphanus*, the fairy shrimp. Mr. W. P. Marshall, M.I.C.E., exhibited some interesting plants that he had collected with Mr. Pumphrey in Norway. BIOLOGICAL SECTION.—Meeting, September 11th, Mr. W. B. Grove, B.A., in the chair. The following exhibits were made:—By Mr. Herbert Stone, a very interesting series of plants from Budleigh Salterton, including *Erodium moschatum*, *Iris fœtidissima*, *Lycopodium Selago*, *Ruscus aculeatus*, &c. By Mr. E. W. Wagstaffe, *Peziza scutellata*; also coal from Hamstead Colliery, enclosing spores of *Salvinia*. By Mr. W. B. Grove, fungi, *Leotia lubrica* and *Russula claroflava*, from Sutton Park. By Mr. J. E. Bagnall, A.L.S., for Mrs. E. Hopkins, *Arctostaphylos Uva-ursi*, *Sphagnum acutifolium*, *S. fimbriatum* in fruit, and *Dicranella cerviculata*, from Foxfield, Westmoreland; for Miss Gingell, *Clematis Vitalba*, *Picris echioides*, and an edible fungus, *Cantharellus cibarius*, from Dursley, Gloucestershire; for Mr. W. R. Hughes, F.L.S., *Festuca rigida* and *Catalpa syringæfolia*, a fine tree, native of North America, from a plantation near Rochester; for Mrs. Coker Beck, the rare *Gentiana germanica*, and a fungus, *Spathularia flavida*, from Crowell, Oxfordshire. GEOLOGICAL SECTION.—September 17th, Mr. T. H. Waller, B.A., B.Sc., in the chair. Mr. Wilkinson exhibited: *Selenite* crystals, and a collection of fossils, including

Ammonites, from the Oxford clay at Weymouth; a rare swimming crab, *Polybius Henslowii*; a collection of butterflies from the neighbourhood of Weymouth, including the Marbled-white *Hipparchia Galathea*, the Grayling *Hipparchia Semele*, Chalk Hill Blue, *Polyommatus Corydon*, and Lulworth Skipper, *Hesperia Actæon*. Mr. W. B. Grove: *Agaricus serrulatus*, *A. asprellus*, *A. carneus*, *Bolbitius hydrophilus*, and *Lactarius chrysorrheus*, from Corley; and *Ag. hæmactus*, from Ansty, for Rev. D. C. O. Adams. Mr. Bagnall: *Vicia tetrasperma*, *Sparganium neglectum*, *Epilobium tetragonum*, and fungi, *Hydnum repandum*, *Cortinarius elatior*, and other fungi from Wappenbury. Mr. W. Pumphrey, as a delegate of this society, gave a report of the Meeting of the British Association at Bath. Mr. Hughes drew the attention of the Council to the death of Mr. Philip Hy. Gosse, and he and several members of the Council expressed their deep sense of the loss science had sustained by the death of such a man. Mr. Bagnall exhibited, for Mr. T. Hooper, *Drosera rotundifolia* and *Myosotis cæspitosus*, from Cannock Chase. Mr. Marshall exhibited and described the cylinders of the graphophone, by Tainter.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 20th. Mr. W. Dunn exhibited rock specimens from the Arctic Regions, said to contain gold and silver; Mr. Corbett, specimens of *Avicula contorta* and *Astræa liassica* from the Rhætic beds, Knowle; also quartz containing gold from Merionethshire; Mr. W. Dunn then read a paper on "Planarian Worms." The commonest forms of these objects are found in almost every pond gathering, and may be seen gliding over the surface of the glass. These worms bear characters that readily distinguish them from leeches, for which they are often mistaken. They have no suckers or feet, the body being covered with cilia, by which they are able to move. Their mode of life is never parasitic. Their cellular and muscular structure, digestive organs, methods of feeding, nervous system, eye spots, and respiratory organs were spoken of, and the development from the eggs and multiplication by budding and fission described. The writer said really very little was known of these creatures, and students of pond life might profitably devote some time to the subject. A discussion on the paper closed the meeting.—August 27th. Mr. J. Madison exhibited a case of *Limnæa peregra*, showing its named varieties and their variability, and gave a short account of their habitats and geographical distribution; Mr. P. T. Deakin, a case of Bulimus, Pupa, Clausilia, and other shells, calling attention to the clausilium of the Clausilia and the operculum of Cyclostoma; Mr. J. Moore, a number of Helices, &c., and their odontophores; Mr. Camm, the following fungi, *Diachæa elegans* and *Tremella sarcoides* from Hamstead, and *Ascobolus furfuraceus* from Harborne; Mr. A. T. Evans, specimens of stick-lac on twigs of trees from India. Under the microscope, Mr. H. Hawkes showed *Stemonitis ferruginea* from Hamstead.—September 3rd. Mr. P. T. Deakin showed a collection of ferns from Hong Kong; the Curator, section of *Atropa belladonna*.—September 10th. Mr. P. T. Deakin presented to the library a collection of mounted microscopic fungi, with observations. Mr. W. Harcourt Bath exhibited a specimen of *Astromyx lovonii* from Aberdeen, a starfish rarely taken in British waters, also a specimen of *Echinocardium pinnatifidum*, and one of an allied species as yet unnamed, both from the Scilly Isles. Under the microscope, Mr. J. W. Neville showed the fructification of a fern, and the same object

in a fossil state in a section of coal-ball material. Mr. H. Hawkes, slides of *Tilmadoche nutans* and *Thelephora laciniata*. Mr. W. B. Grove made a few remarks on the Myxomycetes, describing the difference between an ordinary fungus and a myxomycete. The former when germinating produced mycelia, the latter amœboid forms; these, called myxamœbæ, coalesced, and though the individual amœbæ could not be made out, yet the whole mass of the plasmodium slowly crawled. When it had taken sufficient food it began to assume its mature form, and then hardened to a horny consistence, and the internal protoplasm separated into spores. This completed its life history.—September 17th. Mr. P. T. Deakin exhibited a specimen of *Planorbis carinatus* var. *alba* from the Stratford Canal. Mr. H. Hawkes the following fungi, *Agaricus phalloides*, *A. mollis*, and *Lactarius rufus*. Mr. W. H. Bath, a Dragon Fly, *Gomphus*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. Evening Meeting, Wednesday, September 19; attendance, fourteen (two ladies). The Secretary reported that the field-day on the 12th was attended by eight members, who went over the fields to Great Stretton, a small village on the old Roman *Via Devana*, returning by road.—Exhibition of Seedvessels: Miss Grundy, Miss Noble, and Mr. Knowles contributed examples of seedvessels of the Umbelliferæ, Cruciferæ, Labiatæ, Sapindaceæ, Cupuliferæ, and other orders; but the finest collection was exhibited by the Rev. T. A. Preston, who had collected and arranged in three trays about one hundred fresh seed-vessels, all of which were carefully named. He had also fine examples of the Brazil nut pod and the huge monkey-pot, containing the Sapucaya nuts. Mr. Headley exhibited a fine specimen of the Oak Beauty moth (*Amphydasis prodromaria*), which he captured last March, near the Victoria Park, and which had not been previously recorded in the county. The Chairman stated that he had measured the growth of a plant of *Antirrhinum majus*, from August 13th, when it was 11½in. high, to September 19th, when it was 26in., and found that its rate of growth, which was at first ⅛in. per day, gradually increased to ½in., the most rapid growth being that of the flower spike after emerging from the upper leaves. A paper on "The Parasitic Phanerogams of Leicestershire" was read by Mr. Thomas Carter, LL.B., including the genera Lathræa, Orobanche, Cuscuta, and Viscum as undoubted parasites, and those of Rhinanthus, Bartsia, Euphrasia, Pedicularis, and Melampyrum as somewhat doubtful. The author referred to the theory that some of these parasites, having no chlorophyll, were compelled to seek their carbon from the juices of other plants, or, as it is sometimes stated, having learnt to live upon the labour of others they gradually ceased to produce chlorophyll, but pointed out that there were difficulties in the theory in either form. The Misletoe has abundant chlorophyll even in the roots which penetrate the branches of its host, and the Orobanches often grow to a much larger size than the little plant upon whose slender root they have seized, and which yet does not seem much the worse for their embrace. A lively discussion followed, during which the Rev. T. A. Preston stated that he had once taken the trouble to trace the root of an Orobanche which gradually diminished to a very slender thread, and at the distance of six feet horizontally he found it attached to a rootlet of *Centauria scabiosa*. The Orobanche had other roots which descended into the soil.

THE LIFE-HISTORY OF A MYXOMYCETE.*

BY T. P. BLUNT, M.A., OXON.

A tree had fallen down the steep bank on the further side of the river, and its broad exposed roots formed a warm and shady nook with the soil from which they had been torn; the cavity was partly filled with fallen leaves, and scattered over these were some white spots, as large as half-a-crown, of semi-fluid substance. The source of them was found to be a mass of similar substance, eight to ten inches across, partly hidden among the roots of the tree. This mass resembled clotted cream more than anything else, both in appearance and consistence, but it was of dazzling whiteness. The layer may have been from a quarter to half an inch thick, and it had overflowed in the manner described on to the leaves below. It had a strong fungus-like smell. A little of the substance was taken home, and examined under the microscope; it was finely granular, and streaming movements were observed in it, which at the time were thought to be accidental, but have since been ascertained to be characteristic of it.

The spot was visited at intervals, when the following changes were observed:—First, a delicate and beautiful purple tinge began to show itself on the surface both of the original layer and of the drops upon the leaves. This deepened in tone gradually, until it became a deep full black, and then it was noticed that the mass was no longer formless, but now consisted of a collection of bodies not so large as peas, closely resembling tiny puff-balls, and full of a black powder. I had been watching several stages in the life history of Brefeldia maxima, a large species of that division of the fungi called Myxomycetes. I say division "of the fungi" with some little hesitation, for their biological position is still held to be doubtful by some eminent mycologists, and the source of doubt lies in that part of their history to which we have now come. The powdery matter in the round receptacles consists of spores. Let us see how these germinate; if some of them be placed in water on a microscopic slide and kept warm, they will be seen after a short time to swell, and then to burst, upon which a minute piece of white jelly creeps out from the integument. Under a high power this appears to be of a roughly triangular form, and to be furnished with a

* Read before the Caradoc Field Club, September 28th, 1888.

flagellum or "tail," which it uses for purposes of locomotion. Its movements consist partly of jumps through the water, effected by the aid of the flagellum, and partly of a creeping motion over the surface of the glass; under the latter circumstances, it exactly resembles an amœba in appearance, and, like the amœba, it is able to thrust out portions of its substance into the finger-like projections, called pseudopodia. It shews some curious antipathies and predilections; it will creep away from strong light, and towards moderate warmth. After a time, under favourable circumstances, each body begins to divide itself into two, and the numbers of amœba-like organisms thus increase rapidly by the process of fission.

The next stage consists in the coalescence of the isolated bodies into larger masses, and here the microscopist will be reminded of a phenomenon frequently observed in the case of another of the protozoa, not far removed from amœba, viz., Actinophrys; two, three, or more of these will often approach each other, and gradually coalesce into what appears to be a single large organism. This phenomenon is not of the nature of conjugation, but it is a mere amalgamation, usually resolved after a time.

The union of considerable numbers of the amœbiform bodies into larger masses, and the subsequent coalescence of the latter, result in the snowy cream-like substance from which we started, as found, in the case of Brefeldia, upon the roots of trees, and it may be well now to trace a little more minutely the subsequent stages of its growth.

It is endued, like the units of which it was originally composed, with motile power. It is capable of creeping over surfaces in order to avoid unfavourable conditions or to seek advantageous ones, and this movement can sometimes be followed by the unaided eye.

The mass also increases rapidly in size by the absorption of nutriment from the substratum, and is capable, as we have seen, of overflowing its borders and dropping on to neighbouring surfaces.

It seems probable that the plasmodia—as the masses are called which are formed by the coalescence of the zoospores—have another property which brings them very near to the protozoa, that, namely, of supporting themselves in some measure by the absorption of solid food; they certainly approach, embrace with their pseudopodia, and ultimately engulf small particles of solid nutrient material, which they eject at a later stage.

As has been already stated the surface of the plasmodium in Brefeldia gradually acquires a purple and ultimately a black

colour. Concomitantly with this change of tint differentiation occurs in the substance, the surface becomes warty, the membranes which will ultimately become the "peridia" or walls of the receptacles are secreted, and within them is enclosed the spore plasm. This divides, for the most part, into a number of minute fragments which become coated with cellulose and form the spores; some portion of it, however, is converted into the "capillitium," a delicate network of threads running amongst the spores, the function of which is not in all cases quite clear. Nearly the whole of the plasmodium is, in the case of Brefeldia, used up in the formation of the receptacles, or "sporangia" as they are called, and their contents.

The spores, in the case of Brefeldia, seem to escape simply through the decay and breaking down of the receptacle, but in some species of Myxomycetes the capillitium assists, by its elasticity, in the rupture of the sporangium and the dispersion of the spores.

The curious mixture of animal and vegetable attributes observed in the Myxomycetes, has led some naturalists to give them the name of Mycetozoa, or "fungus-animals," a thoroughly appropriate term, for, as we have seen, the organism whose history we have been considering, exhibits during two-thirds of its life the characteristics of an amœba, which is unhesitatingly classed among the animals; while in the remaining third it so closely resembles the common puff-ball, as actually to have received the synonym of Lycoperdon Epidendron—"tree-puff-ball." We have here one more proof, if more were needed, of the impossibility of laying down inflexible lines in the classification of natural objects. Classes and divisions melt insensibly into each other, and have in fact no real existence except as mental conceptions, useful for the orderly apprehension of natural phenomena, but limited in their application. To a want of recognition of this limit may be traced many fruitless and constantly recurring discussions.

I should like to ask your attention for a few minutes to a speculation as to the cause of the remarkable colours assumed by the Myxomycetes; these are principally bright yellow, reddish yellow, and black, the latter reached in Brefeldia, through deepening shades of purple. There is no doubt that light is inimical to the delicate protoplasm of which the plasmodium is formed, and it has long been known that some species exercise their motile power in order to avoid it. Professor Allman in his address to the British Association, nine or ten years ago, drew attention to this property in Fuligo, or as it was then called Æthalium, the "flowers of

tan." We have seen that our Brefeldia selected the shadiest situation attainable for its habitat, and it is certain from the investigations of numerous enquirers, my own among the number, that colourless protoplasm cannot encounter strong and continuous light, without serious injury, if not death.

In a paper which I read in this place last year, I drew attention to the protection against the injurious action of light afforded to the colourless protoplasm of the plant by chlorophyll, or the green colouring matter of leaves and other organs; and the intense colouring of the Myxomycetes, I am convinced has a similar function. Its history, however, is very different from that of chlorophyll. It is in no way dependent on light for its production, but is, as I have proved by direct experiment, formed in normal quantity in complete darkness. The true explanation of its appearance is, I believe, to be found in adaptive variation, in its most simple and typical form. Individuals which had acquired a slight tint through causes perhaps quite independent of light, were able to exist in situations more favourable to their growth in other respects, but impracticable for their unprotected companions, owing to strong illumination. Thus a distinct advantage was conferred upon the coloured specimens, resulting in greater robustness and permanence, and so in the course of successive generations just those colours came to be developed which afforded most protection against the injurious influence of light.

INSULARITY.

BY THE REV. H. H. SLATER.

(*Concluded from page 246.*)

Let me assure you that this picture of purposeless slaughter and suffering is not in the least degree overdrawn, but only such as I have myself witnessed over and over again, and such as may be seen in suitable localities on our coasts every autumn. And the actors are apt to use the word "sport," and to say that they have enjoyed "good sport" and so on. Sport, forsooth! If this were the general meaning of the word "sport," field sports would deserve to be doomed to-morrow, and would die unregretted by all who had any of the feelings of a gentleman or a Christian. Happily the humanity of real sportsmen is not a thing which requires to be demonstrated.

To return to the collector. He is a person, as a rule, who takes no sort of interest in the structure or habits of the

creatures he amasses the mummies of—a creature is of no value to him until it has been killed and filled with wires and cotton wool, or put in a drawer with a pin stuck through it. His ambition is to have as complete a collection as possible of the birds, insects, or plants of his vicinity. How far the appearance of those objects is connected with the nature of the soil, or the seasons, and what functions they discharge, are matters that do not enter into his ken; enough for him that he has examples of them in his collection. On the whole, it is much to be regretted that persons afflicted with the "cacoëthes possidendi" do not more generally turn their attention to second-hand postage stamps.

Not but what they do at times benefit science by turning up an unexpected species; but, as a rule, they miss the great rarities for want of accurate knowledge. Not but what, too, the possession of specimens not unfrequently generates a wish to know more of them, which leads to better things. But I should consider that the good they do is quite counterbalanced by the evil; for it is impossible for some of the more conspicuous birds, such as the golden oriole, the hoopoe, and the larger birds of prey, to get a footing in our country, owing to the ceaseless vigilance of the collector; and some birds are verging on extinction, as British residents, owing to their senseless persecution by game-preservers, and the high prices that collectors will give for their eggs.

I would implore all who are anxious to obtain the eggs of the rarer British birds, to be content with foreign specimens, from countries where they are abundant enough not to be missed. I have not the least doubt that I have found thirty nests of the woodcock in Britain, but I have only one egg, and that was an addled one. And I have taken one egg of the crane, and that was addled also.

Foreign eggs and skins are quite as valuable for purposes of study and comparison as those taken at home, and we naturalists ought to set our faces against insularity in the shape of the unjustifiable and injurious rage for British-killed skins, and British-laid eggs of those birds which are within a measurable distance of extinction in our islands. I will just add here a little story, which is not, I think, an unfair skit upon the mere collector. It was of a Yorkshire collier, who had just lost his only child, and who was being condoled with by a friend. He said, tearfully, but with earnestness, "Ah dew wish ah'd had t'lyle beggar stuffed."

I cannot help looking upon the Wild Birds' Protection Act as a specimen of insularity. In so doing I would not be thought to question the propriety of its main object—far from

it. The brutalities of the sea-side gunner are notorious and abominable, and every one is heartily anxious to secure the sea-fowl from his cruelty, and, for the matter of that, to secure the land-birds from an almost equally pitiless trio—the village loafer, the game-preserver or game-keeper, who looks upon nature as a vast establishment, in which he is a main actor, for raising the greatest possible number of young pheasants and partridges; and, thirdly, the farmer who is prejudiced and undiscriminating enough to see in the presence of any kind of bird whatever the attack of a direct foe. But the Act itself bears evidence of having been the work of those who had very little practical knowledge of their subject, with the assistance of a few third-rate naturalists and sentimentalists. The schedules containing the names of the birds are simply ridiculous. And the consideration of the Act leads me to notice its practical injustice. In no other country of which I have any experience is the scientific worker treated by the legislature with such contemptuous indifference as in this. Our Government does very little indeed, comparatively, for the science which enriches and ennobles the country—does not even go the length of securing facilities. The English ornithologist, who is suddenly brought face to face with, perhaps, a unique opportunity for adding a new record (as the cant word of the day has it) to the Fauna of his country—if it be during the close season, and he a person of any sensitiveness—must naturally hesitate to incur the familiar indignities of the English law. He is well aware of the "Old Bushman's" dictum, which has passed into a common proverb with ornithologists, that "what is hit, is history; what is missed, is mystery." But he also knows, that if he gave the rein to his scientific enthusiasm, and had the ill-fortune to be brought in consequence before the Bench to answer for his enormities, the magistrates, however much they might sympathise with him, would be powerless, and would have to lay on him a penalty, and a stigma, which the right hon. member for Derby, in his well-known tender gentleness, has put it out of their power to lay upon the back of the prowling loafer, who, for mere greed, shoots a doe hare with helpless young ones dependent upon her.

I cannot see why a recognised worker in natural history should be unable to obtain the privilege of a license to procure during the whole year the few birds he is likely to want, on the understanding that his doing so was, according to his judgment, for the benefit of science, and that he satisfied the requirements of the Inland Revenue Board in the matter of a game license. Such a document, countersigned by the

presidents of the British Ornithologists' Union, and of the Zoological Society of London, would surely be a sufficient safeguard against abuses. I have had such a privilege gracefully accorded to me in other countries—notably in a French colony, in the close season.

With this growl I will bring my remarks to a conclusion, hoping I have not wearied you beyond endurance. I will end with expressing my infinite regret that I have been obliged to figure before you at all, instead of listening to our much lamented President, the Lord Lilford, who cannot be present on account of ill-health; who, being a Past Master in the science of ornithology, would no doubt have given us an address really worth listening to.

ON KEW GARDENS AND SOME OF THE BOTANICAL STATISTICS OF THE BRITISH POSSESSIONS.

BY J. G. BAKER, F.R.S., F.L.S.

(Concluded from page 255.)

Or take the history of *Sequoia gigantea* (commonly known in English gardens as *Wellingtonia gigantea*), the prince of all the Coniferous trees, as told in a recent paper by Sir J. D. Hooker (*Gard. Chron.*, N. S., vol. x., pp. 216, 217):—

"The *S. gigantea*, or bay-tree (the *Wellingtonia* of British gardens), again, is a plant of a cooler climate [than that of the Californian lowlands], and hence having survived the glacial cold was enabled to establish itself in the Sierra Nevada, under certain very restricted conditions. It extends at intervals along the western slope of the Sierra to a little north and south of the parallels of 36° and 38° N., that is for nearly 200 miles in a north-west and south-east direction, at an elevation of 5,000 to 8,000 feet above the sea. Towards the north the trees occur as very small isolated groves of a few hundreds each, most of them old, and interspersed amongst gigantic pines, spruces, and firs, which appear as if encroaching upon them. Such are the groves visited by tourists (Calaveras, Mariposa, &c.). To the south, on the contrary, the Big Trees form a colossal forest, forty miles long and three to ten miles broad, whose continuity is broken only by the deep sheer-walled canons, that intersect the mountains. Here they displace all other trees, and rear to the sky their massive crowns; whilst seen from a distance, the forest presents the appearance of green waves of vegetation, gracefully following the complicated topography of the ridges and river basins which it clothes. . . . .

"The millennia during which these *Sequoia* trees must have remained *in statu quo*, proving the long duration of existing conditions of climate, are but as minutes compared with the time occupied by the migration of this very species or its ancestors north and south in the continent of America. Whatever might otherwise be the extent of the *Sequoia's* travels, they are now at an end. Man has pronounced the sentence, 'Thus far shalt thou go, and no further.' The doom of these noble groves is sealed. No less than five saw-mills have recently been established in the most luxuriant of them, and one of these mills alone cut, in 1875, two million feet of big-tree lumber; and a company has lately been formed to cut another grove.

"In the operations of the Californian wood-cutters the waste is prodigious. The young manageable trees are first felled; after which the forest is fired to clear the ground and get others out, and thus the saplings are destroyed. More destructive yet are the operations of the sheep-farmers, who fire the herbage to improve the grazing, and whose flocks of tens of thousands of sheep devour every green thing, and more effectually than the locust. The devastation of the Californian forests is proceeding at a rate which is utterly incredible except to an eye-witness."

The value of the wood annually wasted through fires at the present time in the United States is estimated by Professor Sargeant at twenty-five million dollars.

Indian Forests.

In India fortunately the state of things is very different. For a long time a large area of forest has been under Government protection, and there is a regular forest department fully organised as a branch of the Civil Service. The results have been most satisfactory, for not only have the forests been kept up for the benefit of succeeding generations, and new trees planted when old ones have been cut down, but the department yields a handsome profit annually. Twenty years ago its annual receipts were 36 lakhs of rupees, and the charges were 22 lakhs, leaving a balance on the right side of £140,000 a year. In 1882-3 the receipts were 95 lakhs of rupees, and the expenses 60 lakhs, leaving a balance of £350,000 on the right side. Dr. Brandis, who for nineteen years has been the director of the department, has lately retired. The total area of protected forest is now 35,242 square miles (about two-thirds of the area of England).

To individualise the different timber trees is of course one of the principal tasks with which the officers have to deal.

Dr. Brandis worked at Kew for a couple of years in the preparation of a hand-book of the timber trees of the North-west provinces; and one has been written for the Madras Presidency by Colonel Beddome, and one for Burmah by Dr. Kurz. A most valuable general handbook of all the Indian timbers has lately been published by Mr. J. S. Gamble, in which 906 species belonging to 482 genera are included. In the American forest there are over 400 different species; in Britain only about forty.

SUMMARY.

To sum up, then, I would say that, to understand properly what is to be seen at Kew, a visitor must bear in mind that four separate and more or less distinct objects are aimed at, and that the different departments fit into one another closely and work together hand in hand along four more or less distinct grooves. Firstly, the Gardens are a holiday resort for a large mass of the general non-scientific public. Secondly, they aim at helping horticulture by exhibiting in a living state a series of the principal types of structure, and by furnishing a means of identifying the plants that come into the country. Thirdly, they aim at promoting systematic botany by furnishing a means of identifying the plants, more especially of the British possessions abroad, or of those collected by British expeditions or private travellers in other parts of the world. And fourthly, the establishment has its economic sphere of usefulness, on which I have already fully expatiated. About the Laboratory and the Picture Gallery I have said nothing, but the uses of these need no explanation. I think the main drawback which all the officers of the establishment more or less feel is that amidst this crowd of aims and the vast mass of details, it is impossible for them to concentrate their attention upon any one thing for any considerable length of time.*

* Since this valuable paper was read the authorities of the Royal Gardens, Kew, have issued a monthly serial, in which is given information similar in nature to that given above. This serial is entitled a "Bulletin of Miscellaneous Information." The first number was published in January, 1887, and was prefaced with the following:—

"NOTICE.—It is proposed to issue from time to time, as an occasional publication, notes too detailed for the Annual Report on Economic Products and Plants, to which the attention of the Staff of the Royal Gardens has been drawn in the course of ordinary correspondence, or which has been made the subject of particular study at Kew. It is hoped that while these notes will serve the purpose of an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire, they may also be of service to

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 224.*)

"The New Botanists' Guide," by Hewett Cottrell Watson, was published in 1835. The list of plants for the county of Worcester is founded almost entirely on materials supplied by the late Mr. Edwin Lees. In addition to the list contained in the "Illustrations of the Natural History of Worcestershire," Mr. Lees furnished Mr. Watson with a checked catalogue of plants in Worcestershire or on its borders. The latter, distinguished by Mr. Watson by the words "Lees' cat.," include the following records, the localities in many instances being unhappily omitted:—

Papaver hybridum. *See "Botany of Worcestershire," p. 39.*

P. hybridum is in Pitt's List, 1810, see "Midland Naturalist," Vol. X., p. 201, where, however, I affixed to it a sign of discredit.

Hesperis matronalis. Occurring sometimes, but obviously a garden outcast.

† **Sisymbrium Irio.** *Must, I think, be an error.*

‡ **Isatis tinctoria.** On a marl cliff close to the Severn, Mithe Toot Hill, Tewkesbury, where the Severn divides Worcestershire and Gloucestershire. *This locality is in the county of Gloucester.*

Reseda lutea.

† **Stellaria nemorum.** *Must be an error.*

Geranium pyrenaicum.

† **Genista pilosa.** *An error. Said to have been gathered at Little Malvern by the late Mr. Borrer. See Lees "Botany of Worcestershire," p. 73.*

Rubus suberectus.

R. rhamnifolius.

R. Kœhleri.

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members of the general public interested in planting or agricultural business in India and the Colonies.

"W. Thistleton Dyer, *Director.*

"1st of January, 1887."

This work has appeared regularly, and has been well sustained. The information supplied has been both valuable and of interest to all who take an interest in the prosperity of our colonies, and gives one a better idea of the good work which is being done at Kew than could be obtained from any other source. The bulletin is issued to the public at twopence per number, and is printed by Eyre and Spottiswoode. J. E. B.

Potentilla verna. Rocks and summit of the Malvern Hills. *Recorded by Southall, 1825, and in "Midland Medical and Surgical Reporter," 1828. If the above belong to Hereford, this will be the first Worcester record.*

Rosa sepium.

R. systyla.

Myriophyllum verticillatum.

† **Cicuta virosa.** *An error.*

Sison Amomum.

Torilis infesta.

Coriandrum sativum.

Fedia dentata.

Lactuca virosa.

† **Vaccinium Vitis-Idæa.** Lower Bromsgrove Lickey. *Must, I think, be an error.*

Pulmonaria officinalis. By the side of a wood at Lower Sapey, apparently wild, in 1834.

† **Asperugo procumbens.** *Must be an error.*

Myosotis collina.

M. sylvatica.

Mentha gentilis.

† **Calamintha Nepeta.** *Must be an error.*

† **Salvia pratensis.** *An error.*

Centunculus minimus.

Chenopodium hybridum.

C. urbicum.

C. polyspermum.

Rumex pulcher.

Quercus sessiliflora.

Carpinus Betulus. Not common.

Populus canescens.

Salix Russelliana, var. of **S. fragilis.**

S. vitellina, var. of **S. alba.**

S. amygdalina, var. of **S. triandra.**

S. cinerea and var. **aquatica.**

Narcissus poeticus. Found in a dubious spot. (*Not a native.*)

† **Allium arenarium.** Battenhall, near Worcester. On red marl.

This must be intended for the Allium arenarium of Smith's "English Flora," Vol. II., p. 134; a form of Allium Scorodoprasum, L. I suspect an error. The species is not certainly known in England south of the county of York.

Lemna polyrrhiza.

Luzula Fosteri. Cotheridge. Rev. A. Bloxam.

Eriophorum vaginatum.

† **E. gracile.** *An error.*

Carex divulsa.

† **Ammophila arundinacea.** *Must be an error.*

Bromus erectus.

* **Lolium temulentum.** The var. arvense of this species is noticed by Purton.

Senecio squalidus. Walls near the Cathedral, and adjoining the river at Worcester. Is inserted in the list on the authority of the Rev. A. Bloxam.

About the time with which we are now dealing, William Addison, F.L.S., surgeon to H.R.H. the Duchess of Kent, was in practice at Malvern. Mr. Lees, in the first edition of his "Botany of the Malvern Hills," 1843, acknowledges his obligations to him. In the second edition of the same work, 1852, he mentions that his friend Dr. Addison, F.R.S., has now left Malvern. The fourth volume of "The Transactions of the Provincial Medical and Surgical Association," London and Worcester, 1836, contains, p. 82, an article by Mr. Addison "On the Medical Topography, Statistics, &c., of Malvern, and of the District at the base of the Malvern Hills." At pages 141 to 146, under the head of Appendix No. 1, is "a List of the Rarer Plants indigenous in the District." After the Flowering plants and Ferns is a list of Mosses, Hepaticæ, and Lichens, for which, as the author informs us in a foot note, he was indebted to two very accomplished young ladies. The Flowering plants and Ferns are 122 species, whether from original observations of Mr. Addison, or by whom communicated, there is no evidence to show. Certain it is that out of the 122 species all but 8 were published by Mr. Lees two years previously in the catalogue to "Hastings' Illustrations," and many of these in "Loudon's Magazine, 1830." Two more are marked "Lees' Cat." in Watson's "New Botanists' Guide," 1835. The remaining 6 are Spergula arvensis, Angelica sylvestris, Senecio lividus, Mentha Pulegium, Holcus mollis, Poa nemoralis.

Spergula arvensis was noted as a Malvern plant by J. K. Walker, "Medical and Surgical Reporter," 1828; Mentha Pulegium, by Stokes (*fide* Ballard), 1787; Angelica sylvestris was noted as a Worcester plant by Pitt, 1810; Senecio lividus, Sm., is a form of S. sylvaticus, noted by Purton, 1817; Holcus mollis was noted by Edwin Lees, "Stranger's Guide," 1828; Poa nemoralis I believe to be a new county record, to be placed to the credit of Mr. Addison.

In the year 1887 there appeared the first volume of a serial called "The Naturalist," conducted by B. Maund, F.L.S., and W. Holl, F.G.S. It contains a paper by Robert J. N. Streeten, M.D., entitled "Observations on the British species of Myosotis." Mr. Towndrow informs me that at page 178 M. collina, Hoffm., is stated to occur "near Hagley, Worcestershire." I am not aware whether any subsequent volumes were published. Mr. Benjamin Maund was the author of an illustrated work on foreign plants, entitled "The Botanic Garden."

(To be continued.) p. 303

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(Continued from page 251.)

But the rock has undergone a great change between Derbyshire and Charnwood. Instead of the thick, massive beds of limestone, of which we have never seen the base, and which must be at least from 4,000 to 5,000 feet thick in North Derbyshire, we find a rapid tailing off in thickness as Charnwood is reached; a tailing off which at Grace Dieu, only 20 miles south of the Derbyshire hills, *has reduced the thickness to about 40 feet.* At the same time the rock loses somewhat its purity, and becomes rather more earthy in character, but there is no intercalation of sandy beds. At Ticknall, as some of you will remember, we have unmistakable evidence of the shelving nature of the bottom upon which the limestone was deposited.

Taking all the evidence together, there can be no doubt that we are approaching once more a *coast line*, for the attenuation of the Mountain Limestone cannot be due to denudation, since we find it overlaid by the Limestone Shales and Millstone Grit.

This new southern land must have been of an entirely different character from the continent bounding the sea to the north. That there must have been clear water nearly close up to the shore is proved by the existence of an organically formed limestone very near the old coast line. That the land must have been of too small an extent to give rise to any

great streams, is shown by the absence of any material incoming of sedimentary strata as the southern shore is approached. This southern land was in fact an *island* bounded by a rocky coast. Of this island the northern portion of the Charnwood area was part, and there is not much difficulty by the aid of natural exposures, and by the results of borings, in determining approximately its extent and shape. It must have been long, narrow, and rocky, and extended from what is now the east coast of Ireland, through the Central Midlands, to an indeterminate point eastward.

The proof of this is afforded by the following facts:—At Coalbrook Dale, in Shropshire, we find an attenuated representative of the Mountain Limestone, very similar to that of Grace Dieu, of the same earthy character, and having about the same thickness. This must also have been a shore deposit, and a line drawn through these two places, which are fifty miles apart, cannot deviate far on either side from the old coast line, which must have had a general trend a little south of west. South of this line lies the Coalfield of South Staffordshire, in which the Coal Measures rest directly upon the older Palæozoic rocks, with the intervention of the Mountain Limestone, so that we are quite sure that the sea in which this latter was deposited did not extend so far south.

From the neighbourhood of Coalbrook Dale the old coast bent round somewhat to the north, for it must have run to the east of the tract occupied by the Shrewsbury Coalfield, where, just as in South Staffordshire, the Mountain Limestone is absent under the Coal Measures. Mantling round the hilly district of North Wales are undoubted beach deposits of Lower Carboniferous age, and by means of these we can trace, with close approximation to accuracy, the old shore line in its course northward and westward between Anglesea and the mountains of Snowdonia to the margin of the Irish Sea.

The western limit of the old island was doubtless where are now the mountains of Wicklow in Ireland, and its southern coast is clearly marked for some distance across South Wales.

On its southern side, in what is now South Shropshire, was a deeply cut little inlet or bay, the existence of which is indicated by the small outlying representatives of the Carboniferous Limestone in the Clee Hills. That there was land on the eastern side of these hills is shown by the Coal Measures of the Forest of Wyre resting on the older rocks, without the intervention of any members of the *Lower Carboniferous*. From this point to Northampton, almost due

east, we have no direct evidence to guide us, but at or near the latter place a series of borings through a great thickness of the overlying Secondary Rocks has proved the existence of a sandy and degenerate representative of the Mountain Limestone, thinning out northwards against land rising rapidly in that direction.*

It can be shown by a similar line of reasoning that these old Carboniferous seas, which spread over the greater part of the southern and northern portions of our country, were really arms or inlets of a far larger sea which extended throughout the greater part of Northern Europe, far into Russia. Scandinavia formed part of the great northern continent, and from this, as well as from the south, the rivers were constantly bringing down into this island-studded inland sea their freight of sand and mud, whilst in the deeper and clearer portions limestone was being formed.

As the limestone thickened, filling the hollows in the sea bottom, the water necessarily shallowed, and the deposits of sand and mud, which were originally confined to near shore, invaded the now shallowed areas, and gradually, though at first intermittently, rendered the water unfit to support the life of limestone-building organisms.

We can readily understand how, by slowly alternating conditions, sometimes impure limestone, and sometimes mud and sand were deposited over the same areas. These are the conditions under which the *Yoredale Rocks*, the next in upward succession to the Mountain Limestone, were formed. But it is certain that these muds and sands, and the still coarser sediments of the Millstone Grit which followed them, were deposited in a slowly subsiding area. We have seen how the sandy deposits around our present coasts are laid down in comparatively shallow water, and it is manifestly impossible to explain the existence in the Carboniferous rocks of thousands of feet of shallow water deposits, deposits which could scarcely have been made in water deeper than 100 to 200 feet, without supposing subsidence of the bottom to have taken place concurrently with the throwing down of the coarse sediment.

That a subsidence of this kind actually did take place is shown by the fact that each member of the Carboniferous Series creeps over the edge of the deposit below it. The Millstone Grit, for instance, extends beyond the original boundaries of the Mountain Limestone, and the Coal Measures

* Some of the rocks forming this old land have been shown by Professor Bonney to be identical with certain Charnwood Rocks. J.G.S., 1885 Proceedings, p. 48.

again beyond those of the Millstone Grit. This is the phenomenon of *overlap*, which has been so largely made use of in determining the original boundaries, or in other words the *coast-line* of any particular member of the Series.

Up to the present time we have been dealing with sedimentation which took place in salt or brackish water; but, after the deposition of the masses of sandstones and shales of the Millstone Grit, the great Inland Seas, now so shallowed by coarse sandy shoals and mudbanks, became wholly or partially cut off from the ocean, and the water threw down finer sand and clay. We now begin to find traces of old land surfaces, which ever become more and more frequent. Subsidence was still going on, but slowly and intermittently, and the fine clay deposits of the alluvial flats were often for long periods together so near the surface of the water as to support a thick mass of vegetation, the remains of which we now have in our Coal Seams.*

In order to find anything at all approaching the morasses which covered a great part of the surface of the British Isles, and of Northern Europe, in the Coal Period, we must look to the gloomy cypress swamps of the Mississippi. In the Great Dismal Swamp accumulate immense thicknesses of vegetable matter, the product of generation after generation of growing trees and semi-aquatic plants. These masses of peaty matter owe their wonderful freedom from any admixture of sand or silt, to the filtering agency of the marginal belt of reeds and brushwood, which effectually prevents any sediment from mixing with the vegetable mass. Doubtless some such cause as this produced the extraordinary purity of some of our coal seams.

In picturing to ourselves the appearance of those huge, swampy flats of the Coal Period, which covered hundreds of thousands of square miles, we must not imagine a forest growth like that of the present day. The predominating forms, and those whose remains had most to do with coal-forming were *Cryptogams*, and consisted of trees related to our Lycopods or Club Mosses, and to our Equiseta or Horse Tails. These acquired proportions which were truly gigantic as compared with their lowly and degenerated modern repre-

* These land deposits seem to have taken place in the deltas of large rivers, even at a very early period in Carboniferous times, for thin beds of coal are found in Northumberland in sandy and detrital deposits, which are actually contemporaneous with the Mountain Limestone of the Midlands; it is manifest, however, that these could have had but a local extension, and that the conditions favourable for the growth of vegetation over extensive areas were long subsequent.

sentatives. The ferns were mostly of the herbaceous kinds, but some large Tree Ferns also existed, far outstripping in height the noble Tree Ferns of our tropical islands. We look in vain for the higher orders of the flowering plants, for the Phanerogams were only represented by their lowest order the Gymnosperms, which included some Conifers, and a few Cycads. These dense and tangled brakes were not without animal life, for we have found in the Coal Measures remains of scorpions, spiders, cockroaches and crickets. The Coleoptera were also represented, but, as far as we know at present, the Lepidoptera did not yet exist; nor is this to be wondered at when we consider the entire absence of the higher flowering plants. In the waters were numerous fish, but the only known air-breathing Vertebrates were Amphibia, of which the Labyrinthodonts, huge frog-like animals, were the chief. These are known to us principally by the curious hand-like footmarks which they left upon the mud.

The remains of these great sub-tropical forests must have formed originally very thick masses of peat, probably ten or twenty times thicker than the coal seams they were destined to become. This peat consisted, for the most part, of the decomposed cellular tissue of plants which grew upon the spot; and, within the last few years, we have had a curious piece of evidence to show that the initial decomposition of the tissue was effected, not by the mere chemical action of air and moisture, but by the agency of those minute living organisms which we now recognise as playing such an important part in all putrefactive and fermentative change. That there are some of you here to-night who are specially interested in bacteriology, must be my excuse for referring somewhat at length to this interesting fact which, as far as I know, has not yet found its way into text-books.

In the year 1879 Van Tieghem announced to the French Academy of Sciences that he had discovered in certain microscopic sections of plants from the Coal Measures of Saint Etienne, undoubted traces of a minute organism well-known to bacteriologists as *Bacillus Amylobacter*. This Bacillus is very active in the destruction of the cellulose of vegetable tissue, and is identical with Pasteur's butyric acid ferment. So we see that in the marshes of the Coal Period plants underwent decomposition by identically the same agent as they do at the present day, and that even at this very remote time, probably separated from our day by millions of years, this Bacillus was at work partially destroying the dead tissues of the higher plants, and facilitating their conversion into coal for our use. This is the only well authenticated

case, as far as I know, of the discovery of a fossil bacterium,* and it is a suggestive fact that, whilst in course of untold ages its contemporaries high up in the scale of existence have undergone enormous change, this lowly organism is to-day both morphologically and functionally what it was in the Coal Period.

In order that you may picture to yourselves the relation of land and water in the British Islands during the Coal Period, I must refer you once more to the map of Lower Carboniferous times. You must imagine that all the area marked as sea has been converted into very shallow water or swampy ground, and that these lagoons have somewhat encroached upon the old shore lines, thus reducing the area delineated as land on the map. The great Central Island still existed, but it was narrowed somewhat, and perhaps also split up into a chain of two or three islands. The Southern Uplands of Scotland, which stood above the water in Lower Carboniferous times, were now submerged, and the island of the Lake District became much smaller. Still, on the whole, the general distribution of the land was pretty much as it was when the Carboniferous Limestone was deposited, and this must have been occasioned by the land areas not participating to the same extent as the sea bottom in the slow downward movement which admitted of the accumulation of so many thousand feet of strata.

This is sufficiently indicated in the case of the Central Island, by the great thinning out of all the strata as we approach its northern shore. The Coal Measures, for instance, in our Ashby Coalfield are about 2,500 feet thick, and probably were originally 3,000 feet; these as they approached the barrier ridge southward have thinned out in North Warwickshire within a distance of only 12 or 14 miles to 600 feet.

But we have independent testimony to the fact that the land of our Central Island was comparatively stationary whilst the sea bottom was subsiding, and that the amount of subsidence increased from the Island towards North Derbyshire. This evidence, to which but little or no attention has hitherto been paid, is as follows:—

In our Ashby Coalfield the largest and most valuable seam is that known as the *Main Coal*, which consists of two beds, the Over and the Nether Coal, with a thickness of 5 and 7 feet respectively. In the northern part of the Coalfield

* Béchamp's observations on his supposed fossil microzyme of the chalk—*Microzyma cretæ*—have been found to be erroneous.

these coals are separated by as much as 60 feet of sedimentary strata, but when traced southwards they are found to come rapidly together, and, at the Moira Colliery, form a single undivided bed of about 14 feet thick. Now we know from the conditions under which coal has been formed that the beds must have been laid down on a perfectly horizontal surface. After a sufficient thickness of peat to form the Nether Coal had accumulated, subsidence must have been commenced, which gradually increased in amount towards the north, and thus effectually prevented the continued growth of the peat bed in that direction, whilst in the south the growth was uninterrupted. By and by subsidence ceased, and allowed the forest growth which was to produce the Over Coal to spread once more over the whole area. In this way only can we account for the splitting up of a coal bed.

Both in the Warwickshire and in the South Staffordshire Coalfield we find this splitting up of the Coal Seams even more marked than it is in our district, and the splitting up in both cases takes place, as in our Ashby Coalfield, *towards the north*. In the South Staffordshire district, in the neighbourhood of Dudley, the ten yard Coal, as it is called, is an undivided seam thirty feet thick; but when traced northwards within a distance of a few miles it divides into *nine* distinct seams, separated by an aggregate thickness of 420 feet of Sandstone. The combined thickness of these nine seams of Coal is only a little short of the original thickness of the undivided seam, so that besides having here a good example of horizontally progressive and intermittent subsidence, we have an indication of the extreme slowness with which the peat beds must have increased in thickness. The time taken to accumulate 420 feet of sedimentary strata was only sufficient to add at the outside a foot or two to the thickness of the coal seam.

(To be continued.)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, B.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 260.)

Sub-genus X.—Volvaria.

158. **Ag. volvaceus,** *Bull.* Stoves. Rare. July. Cucumber frame, Rev. E. H. Knowles, Kenilworth, July, 1871, *Russell, Illustr.*

154. **Ag. speciosus,** *Fr.* Dung-hills. Rare. Oct. Crackley Wood, Kenilworth, *Russell, Illustr.* Lane near Hams Hall. on waste heap. [Also near Sutton Park, but in Staffordshire.]

155. **Ag. gloiocephalus,** *DC.* On the ground. Rare. Kenilworth, *Russell, List.* Near Brinklow, *Adams.*

156. **Ag. parvulus,** *Weinm.* Pastures. Rare. Oct. The Moats, Ansty; Shilton field, *Adams.*

Sub-genus XII.—Pluteus.

157. **Ag. cervinus,** *Schæff.* *Ag. latus,* With. On the trunks of trees. Aug.-Oct. Frequent. Edgbaston, on turf, *With.*, 227. At the base of a dead pear tree, Kenilworth, *Russell, Illustr.* Withybrook, near Brinklow, *Adams.* Driffold Lane; Sutton Park; New Park; Packington Park; Solihull; Olton; Marston Green; Grove Park, Warwick; etc.

Var. *patricius,* Schulz. May-Sept. Shilton, near Coventry, *Adams.* Driffold Lane, Sutton.

Var. *eximius,* Smith. Rare. Warwick Castle Grounds, *Perceval.* Kenilworth, *Russell, Illustr.*

158. **Ag. umbrosus,** *Pers.* Dead trunks. Rare. Stoneleigh Deer Park, *Russell, Illustr.*

159. **Ag. nanus,** *Pers.* On stumps. Rare. Four Oaks Park; Sutton Coldfield.

160. **Ag. chrysophæus,** *Schæff.* On wood. Rare. May-Sept. Warwick Castle timber yard, *Perceval.* Amongst sticks, Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.*

161. **Ag. phlebophorus,** *Ditm.* *Ag. reticulatus,* With. On sticks. May-Aug. Edgbaston Pool Dam, *With.*, 283. Shilton, near Coventry, *Adams.* Sutton Coldfield.

Sub-genus XIII.—Entoloma.

162. **Ag. sinuatus,** *Fr.* Woods. Rare. Sept. Wedgenock Park, *Perceval.* High Down, near Combe, *Adams.* Wood at Walmley; Crackley Lane.

163. **Ag. prunuloides,** *Fr.* On the ground. Rare. Aug. Coleshill Pool.

164. **Ag. repandus,** *Bull.* Very rare. Kenilworth, *Russell, List.*

165. **Ag. ameides,** *B. and Br.* Pastures. Rare. Ansty Fields, *Adams.*

166. **Ag. Saundersii,** *Fr.* On the ground, Shilton, near Coventry, *Adams.*

167. **Ag. jubatus**, *Fr.* Roadsides, in grassy places. Rare. Marston Green; near Barnt Green, on boundary of outlying portion of the county; *Cooke, Illustr.*, pl. 317, exactly.
168. **Ag. griseo-cyaneus**, *Fr.* Fields. Rare. Hopsford, near Brinklow, *Adams.*
169. **Ag. sericellus**, *Fr.* Woods. Rare. Sept. Dalehouse Lane, Kenilworth, *Russell, Illustr.* Marston Green; Trickley Coppice.
170. **Ag. clypeatus**, *L.* Gardens. Rare. Apr.-May. Red Lane, Kenilworth, May, 1865; gardens, Kenilworth, April, 1872, *Russell, Illustr.* The Moats, Ansty, *Adams.*
171. **Ag. rhodopolius**, *Fr.* Moist woods. Aug.-Oct. Under trees, Birmingham Road; Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.* New Park, near Middleton, *Dr. Cooke.* Small wood, near Penns railway station; Trickley Coppice.
172. **Ag. costatus**, *Fr.* Meadows. Rare. Sept. The Spring, Kenilworth, *Russell, Illustr.*
173. **Ag. sericeus**, *Bull.* Meadows. Sept.-Oct. Red Lane and Birmingham Road, near Kenilworth, *Russell, Illustr.* Ansty, near Coventry, *Adams.* Marston Green; Corley; Sutton Park.
174. **Ag. nidorosus**, *Fr.* Woods, etc. Oct. Crackley Wood, Kenilworth, *Russell, Illustr.* High Wood, Combe, *Adams.* New Park and Trickley Coppice, Middleton, *Dr. Cooke.* Newlands Wood, near Hatton; coppice in Packington Park.

Sub-genus XIV.—Clitopilus.

175. **Ag. prunulus**, *Scop.* *Ag. pallidus*, Purt. Woods, etc. Local. Oct. On a hedgebank at Oversley, *Purt.*, iii., 188. Pasture, Kenilworth, *Russell, Illustr.* The Ridings, Combe, *Adams.* Baddesley Park, *Hawkes!* Sutton Park; banks of a small pool near Packington Park.
176. **Ag. undatus**, *Fr.* Pastures. Rare. Kenilworth, *Russell, List.*
177. **Ag. carneo-albus**, *With.* Very rare. Aug. Oversley Hill, *Purt.*, ii., 625.

Sub-genus XV.—Leptonia.

178. **Ag. lampropus**, *Fr.* Grassy woods. Rare. Sept. Bentley Park, *Bloxam.* Corley, *Adams.* Pine wood, Coleshill Heath; near Coughton Park.
179. **Ag. serrulatus**, *Pers.* Amongst grass. Rare. Sept. Corley Woods.

180. **Ag. euchrous** *Pers.* On stumps. Rare. Hopsford, near Brinklow, *Adams.*
181. **Ag. chalybæus,** *Pers.* Grassy woods. July-Sept. Combe Ridings, 1882; Sutton Park.
182. **Ag. incanus,** *Fr.* Pastures. Rare. Fields, Ansty, *Adams.*
183. **Ag. asprellus,** *Fr.* Pastures. Rare. Pastures, Corley! *Adams.*

Sub-genus XVI.—NOLANEA.

184. **Ag. pascuus,** *Pers.* Pastures and waysides. Common. Aug.-Oct. Grassy spot, Crackley Wood; meadow, near Kenilworth, *Russell, Illustr.* Mill field, Ansty, *Adams.* School Close, *Rugby Sch. Rep.* By Trickley Coppice; Marston Green; Sutton Park; Four Oaks; Sutton; Langley; Edgbaston Park; Packington Park; Coleshill Pool; Corley; near Coughton Park, etc.
185. **Ag. mammosus,** *Fr.* Grassy places. Rare. Oct. Pine wood, Coleshill Heath, 1884.
186. **Ag. pisciodorus,** *Ces.* Amongst grass and leaves. Rare. Feb., Oct., Dec. Driffold Lane, Sutton.

Sub-genus XVIII.—CLAUDOPUS.

187. **Ag. variabilis,** *Pers.* On sticks. Rare. Oct. On blackthorn, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.* Sutton Park, on sticks.

Sub-genus XIX.—PHOLIOTA.

188. **Ag. durus,** *Bolt.* Cultivated land. Rare. Aug.-Sept. Dunn's Pit Lane; field, Birmingham Road, near Kenilworth, *Russell, Illustr.* Ansty, *Adams.*
189. **Ag. præcox,** *Pers.* Fields and gardens. Feb.-July. Warwick, *Perceval.* Garden, Kenilworth; Dale House Lane; borders of Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford; Ansty, *Adams.* Edgbaston; Erdington; Sutton; Water Orton; near Oldbury Reservoir; Kenilworth; Packington Park.
190. **Ag. radicosus,** *Bull.* Woods. Rare. Oct. High Woods, Combe, *Adams.* Pine wood, Coleshill Heath.
191. **Ag. pudicus,** *Bull.* Stumps. Rare. Oct. Elder stumps, Ansty Churchyard, *Adams.*
192. **Ag. heteroclitus,** *Fr.* On butt end of logs. Very rare. Oct. Driffold Lane, Sutton; occurring many years in succession, always cæspitose, large and fine specimens, exactly like *Cooke, Illustr.*, pl. 866.

193. **Ag. squarrosus,** *Müll.* On trunks of trees. Sept.-Oct. *Ag. floccosus*, Edgbaston, *With.*, 262. Studley Castle, *Purt.*, ii., 645; Allesley Bree in, *Purt.*, iii., 416. Hams Hall, *Hawkes!* Combe Fields, *Adams*. Sutton; The Grange, Erdington; near Penns railway station; Kenilworth; Trickley Coppice; Lady Wood, Four Oaks; etc.

194. **Ag. spectabilis,** *Fr.* On dead stumps. Oct. *Ag. aureus*, at Oversley, Wixford, and near Broome Court, *Purt.*, iii., 195. Warwick, *Perceval*. Kenilworth, *Russell, Illustr.* By the side of Brinklow Lane, *Adams*. Coleshill Pool; Edgbaston Park; pine wood, Coleshill Heath; Shustoke. *Ag. rheoides*, on hawthorn and alder stumps, Edgbaston Park, and Lane to Curdworth, *With.*, 210, seems to be this species.

195. **Ag. adiposus,** *Fr.* On trunks of trees. Oct. Stump, Malt House Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams*. Driffold Lane, Sutton.

196. **Ag. mutabilis,** *Schæff.* On stumps. Local. Aug.-Oct. Edgbaston, on rotten wood, *With.*, 279. Hopsford, *Adams*. Driffold Lane; Sutton Park; Langley; New Oscott; New Park; Trickley Coppice; pine wood, Coleshill Heath; Alveston Pastures.

197. **Ag. marginatus,** *Batsch.* Woods. Rare. Oct. In the Park at Packington, *With.*, 283. The Spring, Kenilworth, *Russell, Illustr.* Pine wood, Coleshill Heath; Wyndley Pool, Sutton.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 265.)

Agricultural drainage does not cause floods, neither does it materially diminish the supply of water to porous beds, according to some authorities. The question is very difficult to deal with, because very strong and quite opposite opinions are held on the subject. So far as I can judge, farmers, as a class, hold the opinion that under-draining does not help to cause floods, but rather to diminish them, whereas engineers generally hold the opposite opinion. The line of argument taken by the former seems to be about this:—The more thoroughly a soil is under-drained, the more nearly does it resemble a dry sponge in absorbing water, and the less likely is any to flow

off the surface in open watercourses, and so assist in producing floods. It is asserted that such under-draining would tend to diminish floods by deferring the discharge of water from the land in the manner indicated.

The heavy floods of the few years preceding 1884, in Northamptonshire, are attributed to want of drainage rather, for there was then more land wanted draining than there had been for twenty years previously, and this largely because the heavy rains had burst up the drains, and they wanted relaying. The depth to which rain must sink before the drains can act, the slowness of discharge from drain pipes compared with surface discharge, also the large amount of porous upland—estimated at not less than one-third for the district we are particularly concerned with—neither requiring nor having any artificial aids to discharge its water, are pointed to as evidence of the small effect land drainage can have had in increasing floods.

The exact manner in which drains act gives rise to difference of opinion, this probably depending upon the character of the land with which each person is best acquainted. Where a comparatively porous bed rests on an impervious one at a small depth below, the drain pipes will receive most of their water upwards, after the lower portion is saturated; in most other cases the saturation plane would travel downwards rather.

As to whether drainage diminishes percolation sufficiently to seriously interfere with springs from underlying porous beds, it is pointed out that although districts with a deficiency of water are often those where drainage has been most extensive, still the very fact that such drainage is necessary shows that impervious beds constitute the subsoil, and so percolation would be small.

I have already given reasons for the opinion that the marlstone water supply has not been seriously diminished by land drainage.

That land drainage does help to cause floods is, however, a justifiable conclusion, I think, and the chief reasons for this opinion are detailed below:—On stiff, undrained, and badly cultivated land water will stand in the furrows, and everywhere where a concavity exists, for days, and even weeks at some parts of the year, and only get away very slowly indeed by dribbling through weed choked ditches, by percolation into the ground when the water previously there permits it, or by evaporation. Compare this with the condition of well cultivated land, where the watercourses are kept free, and every facility given for the water to rapidly get away, and it

will be evident that the higher cultivation of recent years, of which tile draining is an essential concomitant, must tend to discharge water more rapidly into the valleys. Drainage has for its object the rapid removal of surplus water, and, if it does not do this more quickly than nature, it is difficult to guess its use; it cannot even convert the land into a sponge without first ejecting the water from such land.

The prevalence of the opinion that drainage causes floods is shown by the provision in the Rivers Conservancy and Floods Prevention Bill, brought forward in 1888, for taxing the uplands to the extent of one-tenth for improvements in the lowlands. Whether this was just or not, and whether the assumed proportion of responsibility for floods was satisfactory, I will not pretend to say, but the bill had been preceded, a few years before, by an examination of witnesses before a committee of the House of Lords. These witnesses, although differing much as to the causes of floods, were fairly unanimous in the opinion that floods were more common and higher than formerly, though in some cases they did not last so long.

Efficient draining permits farm work to be renewed very soon after the cessation of rain, and almost always within the limits of time represented by the commencement and termination of the flood, supposing the rainfall sufficient to cause such, and if so, the water removed must have been added to that reaching the valley otherwise, and so assisted in causing and increasing that flood.

The sponge theory of drainage chiefly applies to periods in which the rains are separated by intervals of dry weather, for instance summer time, when a considerable rainfall is required to produce floods at all. Drainage alone will never desiccate the soil; the moisture held by capillary attraction will not be removed at times when the humidity of the atmosphere prevents evaporation, hence rapidity of action in the drains is essential for the soil and subsoil to have any absorptive capacity under such conditions, and these are the most natural conditions during the winter flood period.

Properly laid drains do very promptly begin to act after rain, and herein lies the chief disadvantage incident to drainage. The water is so rapidly carried away when from other sources there is plenty, that much less is left for sustaining the springs in summer. Unless the drains are laid very deep in a stiff soil, or the area drained is large compared with the number of drains in it, they will cease to act about May, whereas natural springs, supplied by the same winter rainfall, will often continue to improve during the

summer, and be at their best in the following autumn. To the causes just referred to must be attributed the complaints of old millers, who depend chiefly or entirely on water, that they have a more frequent alternation of flush and slack water now to contend with than they did, both of which are harmful to them.

There can be no doubt that there is less evaporation from well drained land than from undrained; also that there is more percolation into it. If more water goes in because more has been drained out, the same amount of water reaches the main streams, and as to whether it tends to produce floods or not is a question of time only. The difference between the evaporation from undrained and drained lands is a direct and considerable gain of water which, sometime, must find its way into the valley. To this quantity must be added or subtracted any water that would be arrested in its downward passage to a water-bearing bed, as a cause affecting flood and slack water, if it be allowed that drainage is chiefly operative during flood periods.

What has been said about agricultural drainage does not materially affect the question as to whether the floods of recent years, in the Nen valley, were more violent or more frequent because of more efficient or more extensive drainage —the main cause we all know was excessive rainfall—but refers chiefly to the broader one as to whether floods are at any time increased by land drainage.

The main object of the preceding remarks on agricultural drainage is to show that a great quantity of water is allowed to run away and help to produce floods. This water with a little extra trouble might often be made to feed the porous beds of the district, as I have proposed to feed the marlstone, and so be of immense benefit for the supply of villages throughout the summer, besides somewhat equalising the flow of the river.

(To be continued.)

Review.

The British Moss Flora. By R. Braithwaite, M.D., F.L.S. Part XI. Fam. X., Grimmiaceæ I. Royal 8vo. 8s. L. Reeve and Co.

This is the commencement of the second volume of Dr. Braithwaite's valuable work on the British Mosses, and is of special interest, as forming a complete monograph of the British species of Grimmia and its allies. The part is illustrated by eight plates, giving not only a life-size illustration of each plant, but also magnified representations of all the various parts of each plant, all drawn with the singular

fidelity and exquisite finish peculiar to the author. Beside these, there are fifty-six pages of letterpress, in which we have full and graphic descriptions of each plant, together with those additional familiar notes that are frequently so helpful in difficult and critical groups. The part is one of the ablest and most chastely illustrated portions of the author's great work. We look forward with interest to the publication of Part XII., in which we are promised a full treatment of the genera Orthotrichum and Schistostega, the former being probably one of the least understood groups of our British mosses.—J.E.B.

Wayside Note.

WASPS IN 1888.—Doubtless most of us have noticed that the past season has been very remarkably free from wasps (the writer has not seen or even heard of a single wasp's nest being found in the Midlands). But during the past few weeks of bright sunshine (October) many queen wasps have made their appearance, as though the cold wet season had prevented their establishing nests in the usual way at the usual period. We presume that those queens which will escape annihilation this autumn will appear again next year to propagate the species, provided the weather is suitable. W. S. G.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION.—October 9th, 1888, Mr. R. W. Chase in the chair. The following were exhibited by Mr. W. B. Grove, B.A.:—Fungi collected during the fungus foray in Sutton Park, including *Agaricus terreus*, *Ag. personatus*, *Cortinarius pholideus*, *C. delibutus*, *C. erythrinus*, *Hygrophorus hypothejus*, *Mitrula paludosa*, *Corticium sanguineum*, all new to Sutton Park or district; for Miss Gingell, *Cantharellus cibarius*, *Craterellus cornucopioides*, *Agaricus æruginosus*, and other fungi from Dursley, Gloucestershire; by Mr. Edmunds, *Peziza aurantia*; by Mr. W. R. Hughes, F.L.S., for Mr. Jones, of Sutton Coldfield, *Blatta Lapponica*. Mr. W. P. Marshall read his paper on "Norway Plants," recently collected by himself and Mr. C. Pumphrey, in which he gave an interesting account of the voyage out to the North Cape, the various places visited *en route*, and a vivid description of the glorious phenomenon of the midnight sun. The paper was illustrated with 150 specimens of plants, collected at the various stopping places, and two excellent maps, one of the West Coast of Norway from Bergen to the North Cape, and the other of the Arctic Circle. On the latter was traced the line of lowest mean temperature, showing how this line was displaced 600 miles north of the normal position at the North Cape by the influence of the Gulf Stream.—GEOLOGICAL SECTION.—October 16th, Mr. T. H. Waller, B.A., B.Sc., in the chair. In response to an invitation from the Council to the members of the Vesey Club (Sutton) to attend this, the opening meeting of the Section, several members of that Club were present. After a cordial welcome had been given to the visitors by the Chairman, the following were exhibited:—Mr. W. B. Grove, *Ag. mastoideus*, *Ag. clavipes*, and *Hygrophorus puniceus*, from Dawlish; *Russula virescens*, *R. nigricans*, *Ag. spadiceus*, from Umberslade; Mr. F. Enock, Specimens of Puparia of the Hessian Fly (*Cecidomyia destructor*), *in situ*, in wheat stubble, from

Acocks Green Farm; Mr. J. E. Bagnall, for Miss Gingell, Fungi, *Helvella crispa*, *Cortinarius largus*, *Craterium pedunculatum*, *Hydnum repandum*, and other fungi, from Dursley, Gloucestershire; also several mosses; for Rev. D. C. O. Adams, *Hygrophorus pudorinus*, *Clavaria condensata*, *Cortinarius Berkeleyii*, from Crowell, Oxon. The chair was then taken by Mr. R. W. Chase, during the reading of Mr. Waller's paper on the Rock Specimens recently brought from Norway by Mr. C. Pumphrey. The Rock Specimens were principally gneisses, schists, and pebbles. Considerable interest was excited by the paper, which was illustrated by microscopical sections. Several members and visitors took part in the discussion upon the topics referred to in the paper. Mr. J. B. Stone, on behalf of the Vesey Club, expressed the great pleasure felt by that Club in receiving so warm an invitation from the Natural History Society, and hoped to have the still greater pleasure of receiving the members of the Natural History Society as the guests of the Vesey Club at no very distant date. Professor Lapworth, after personally thanking Mr. Waller for his valuable paper, gave the Section an invitation to the opening address of the Geological Section of the Philosophical Society, to be delivered at the Medical Institute on October 25th, on "The Geology of the Future."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 24th. Mr. W. H. Bath exhibited the larva of *Libellula quadrimaculata;* Mr. J. Madison, specimens of *Anodonta anatina* var. *complanata*, from King's Heath; Mr. J. W. Neville, tropical varieties of Helices. Mr. C. P. Neville then read a paper—"Notes on the Vale of Llyfnant." The writer illustrated the scenery of the vale by a series of sketches, and described its geological, botanical, and entomological features. Insect life was very abundant, four kinds of fritillaries being taken in a few yards. The writer gave lists of the insects captured, and recommended those who love a ramble in Nature's quiet haunts to visit central Wales.—October 1st. Mr. P. T. Deakin exhibited a strangely distorted specimen of *Planorbis complanatus;* Mr. H. Hawkes, under the microscope, *Bulgaria inquinans*, from Hamstead, and *Peziza coronata*, from Knowle; Mr. J. Collins, section of sporocarp of *Pilularia globulifera*.—October 8th. Mr. P. T. Deakin exhibited a collection of marine shells from Malta; Mr. J. Moore, a series of photo-micrographs of parts of insects. Mr. W. H. Bath then read a paper on "Extinct British Butterflies." The writer said the greater part of animals were only found within well-defined limits, no two countries or districts being absolutely identical, and the circumstances that had brought about changes in the past were still exerting their influence on living forms. The butterflies of England only numbered sixty-five species, whilst Continental species were four times as numerous. The writer referred to species that were extinct, *Papilio podalirius* having disappeared within the last century; *Papilio machaon*, once widely distributed, is now only found in the south-east; *Erebia Cassiope* was said to have been with us from the glacial period. An interesting paper was concluded by dealing with the causes that produced the changes, and which were found in physical geography, climate and vegetation.—October 15th. Mr. W. H. Bath exhibited a collection of insects of the order Planipennia made in the Birmingham district; Mr. Barrowdale, a specimen of *Atticus illyllita*, a silkmoth from Bengal, also a number of preserved larvæ and cocoons of British moths; Mr. J. Madison, a distorted specimen of *Planorbis complanatus*, in which the spiral assumed a corkscrew form. Under the microscope, Mr. H. Hawkes showed the following fungi:—*Craterium leucocephalum* and *Physarum nutans;* Mr. J. W. Neville, a curious plant bug (Tingis) from Turkey.

PHILIP HENRY GOSSE, F.R.S.

This eminent Zoologist, who was indubitably one of the most popular—if not one of the greatest—Naturalists that Britain has produced in this nineteenth century, "peacefully passed away in his sleep," on the morning of Monday, 23rd of August last, in the 79th year of his age, after an illness of five months. "Peacefully passed away in his sleep!" The words, viewed by the light of after events, seem to have been almost prophetic. The writer of these lines, who was honoured by his friendship during many years, and who, in common with many others, deplores the loss of a true friend, and the still greater loss which science has sustained by his "passing away," recalls a memorable conversation that took place, in the garden of his quiet and beautiful home, at "Marychurch," now nearly a quarter of a century ago. The topics on which we had been discoursing were of the most momentous nature—life, death, and immortality; and the question was put by the writer, "Would it at all distress your mind if you knew you were to die to-night?" The answer was immediate, clear, ringing, and decisive, "No, it would not." Often and often since have those words been brought back to memory. How beautifully they illustrate the gentle, loving, eminently religious character of the man, and the simple and trustful faith—not unlike that of the old Puritans—in which he lived and died.

The life of Mr. Gosse, which exceeded the three-score years and ten of man, was numbered both by its years and by its activities. Born at Worcester on 10th April, 1810, being the second son of a miniature painter named Thomas Gosse; educated at Blandford; serving first as a clerk in a whaler's office in Newfoundland; then engaged as a farmer in Canada; then teaching as a schoolmaster in Alabama; and afterwards working as a professional Naturalist in Jamaica. What a rich experience. Added to it, was the inherited gift of the father's artistic pencil, and the early enthusiasm of a kind aunt—a Mrs. Bell—who fostered and developed the boy's taste for Natural History. And what was the result? During nearly half a century, from 1840 till 1886, a rich and varied series of works on Natural History, Microscopy, and other subjects, issued from his pen, most of which were exquisitely illustrated by his pencil. The following is a list of the more important of those which pertain to Zoology:—"The Canadian Naturalist," 1840, "The Birds of Jamaica," 1847,

"An Introduction to Zoology" (S.P.C.K. Society, 1848), "Popular Ornithology," 1849, "A Naturalist's Sojourn in Jamaica," 1851, "A Naturalist's Rambles on the Devonshire Coast," 1853, "The Aquarium: An Unveiling of the Wonders of the Deep Sea," 1854, "A Manual of Marine Zoology of the British Isles," 1855-6, "Tenby: A Seaside Holiday," 1856, "Life in its Lower Forms," 1857, "Evenings with the Microscope," 1859, "Actinologia Britannica: A History of the British Sea Anemones and Corals," 1860, "The Romance of Natural History," 1860-1, "Sea and Land," 1865, "A Year at the Shore," 1865, and "The Rotifera, or Wheel Animalcules," 1886 (the last-mentioned work being written in conjunction with Dr. C. T. Hudson). The above list is exclusive of a large number of Papers communicated by Mr. Gosse to the Royal Society (of which he was elected a Fellow in 1856), the Linnean Society, the Zoological Society, and others. Many of the larger works were illustrated by chromo-lithographic plates from the author's own drawings; but singularly beautiful as they are, they fail to give a complete idea of the fidelity to nature, which characterises the originals. Nearly all his works are rising in price, an unfailing tribute to the author's popularity. "The Aquarium" is perhaps the scarcest of all, and, as the lithographic drawings were, we believe, accidentally destroyed some years ago, the book cannot be reproduced in its present form.

In order thoroughly to apprehend the nature and value of Mr. Gosse's labours, as briefly recorded above, we must go back and see what was the literature on the subject of Marine Zoology at the time he did his work. Of the lower forms of Marine life—especially the Hydrozoa and Actinozoa—we knew but little. Sir John Dalzell had published two or three very expensive works on a few rare and remarkable forms, but these volumes were scarcely accessible to the student. It is true that there existed also the careful works of Dr. George Johnston ("The British Zoophytes," &c.), which were an immense advance on either the "Zoology" of Pennant or of Shaw, but all failed in one important respect, namely, *to bring before the enquirer the various forms of Marine life as they actually lived and moved in the depths of the sea.* To quote from an obituary notice in the *Saturday Review* of September last:—"To Mr. Gosse belonged the credit of having by close and carefully recorded observations of the living creatures themselves brought order out of chaos, and led the way to a knowledge of many singular forms which until then had been impossible. But even his labours would have been attended with only limited success had he not

conceived and carried out the idea of a vivarium, in which marine animals and plants could be preserved for a lengthened period, without disturbance of the water, in a living and healthy condition, thus enabling the student to observe and record their habits from day to day, to note the varied phases of their development, their metamorphoses, and other peculiarities."

In plainer words, Mr. Gosse may be said to have almost created the Aquarium. The idea was accepted at the Zoological Society in 1852. Tanks were erected in their gardens, Regent's Park, "in which (so said the handbook issued at the time) the greater part of the British Zoophytes, Crustacea, Mollusca, and a considerable number of Fishes will, in the course of time, be exhibited." Marine Aquaria were subsequently erected in the Jardin d'Acclimatation at Paris, at Hamburg, at Naples, at the Crystal Palace, and elsewhere. In connection with these the name of the late Mr. W. Alford Lloyd must ever be associated, for the singular ability and practical skill with which he grasped the principles and carried out the practical construction of large public Aquaria. Nor in the case of the Naples Aquarium must we omit the honoured name of Dr. Anton Dohrn, who devoted his lifetime and fortune to the establishment and maintenance of that important institution. To quote the words of the *Saturday Review* again:—"Marine Aquaria at once became popular; Mr. Gosse's 'Handbook' reached a new and enlarged edition, and, while the novelty lasted, there was hardly a town in England where, by some enterprising lover of natural history, the experiment had not been repeated." Much of this enthusiasm has passed away, but the effect of it —mainly due to his genius—was to prepare the public mind for such cognate undertakings as the Dredging Expeditions of H.M.'s ships *Lightning* and *Porcupine*, and subsequently, on a still grander scale, that of H.M.'s ship *Challenger*. It is not too much to say in connection with the last-mentioned—the reports of which have regularly appeared during the last nine years, in some fifty magnificent quarto volumes, worked out by all the most eminent Zoologists in the world—that when completed it will be one of the greatest scientific results achieved by any nation at any time. Everyone will, we think, admit, that before Mr. Gosse's day an attempt by Parliament to vote a large sum of money out of H.M.'s Treasury towards such a questionable enterprise as the *Challenger* Expedition would have certainly failed! Yet another institution towards the establishment of which his labours operated as a powerful factor in the

past—Marine Biological Stations. These, which have been established at Naples, Granton, Plymouth, and elsewhere, are but the natural development from the simple Marine Aquarium, with which the names of Gosse, from the biological, and Warrington, from the chemical side, will be inseparably connected. And it is impossible to estimate the benefit which the scientific knowledge and practical good that these Stations will, by discoveries in embryological science and probably in economic fish culture, in the future develop.

To return to Mr. Gosse's work—the appearance of the "Actinologia," with its gorgeously coloured, but accurately drawn plates, and faithful descriptions, was a perfect revelation. The public, and especially those who had a sufficiently cultivated taste to understand it, were until its appearance scarcely aware that such exquisite creatures lived with complicated organisation, variety of form, and brilliant colouration as therein described. Very modest indeed was his estimate of his own work. In the preface, after generously thanking those Naturalists who had assisted him by specimens, or facts, or by verifying localities, he says:—"The result is that seventy-five species find their places in these pages, five of which are merely indicated, leaving seventy good species, exclusive of the *Lucernarida*. Of these, twenty-four only are described in Johnston—the rest of his species being either synonyms or resting on insufficient evidence. Fifty-four British species have been examined by myself, perhaps a larger number than have come under the notice of any other naturalist; by far the greater part in life and health; and thirty-four of these have been added to the British Fauna by myself."

In his splendid little "Manual of Marine Zoology," 1865-6 (wherein there is a figure of every genus, drawn by himself, mostly from life), and which text-book is still highly valued by students, although some of its classification has been necessarily superseded by recent discoveries, he tells us the history of its origin:—"It is now about four-and-twenty years ago, that in a land far remote from this, I began the study of systematic Zoology, with Insects. It is, beyond all comparison, the most extensive class of animals, in fact, all but boundless; but in my ignorance I attacked it entire and indivisible, collecting and trying hard to identify everything that I found from the *Cicindela* to the *Podura*. I had not an atom of assistance towards the identification, but the brief, highly condensed, and technical generic characters of Linnæus's "Systema Naturæ," over which I puzzled my brains, specimens in hand, many an hour . . . . I have

endeavoured in the following pages to furnish, to the Sea-side Naturalist, what the Linnean "Genera Insectorum" were to me. That such a book is a desideratum I need hardly say." His language in this, as in all his works, was always marvellously graceful and accurate; the definition of fishes therein is given as an illustration of what is a masterpiece of scientific acumen:—"Vertebrate animals, having cold blood; breathing by means of permanent gills; inhabiting water; furnished with fins for locomotion; producing eggs."

As previously mentioned, "The Rotifera" (one of his earliest fields of investigation) was the last work undertaken by him, with his accomplished colleague, Dr. C. T. Hudson. It is a most exhaustive monograph of immense value to Naturalists, and the microscopic drawings by Mr. Gosse, executed when he was over seventy, exhibit all the freshness and vigour of his best work.

Space will not permit of further reference to his published writings, but we think that to the general reader, with a taste for natural science, "The Devonshire Coast," "Tenby," "The Romance of Natural History," and "A Year at the Shore," will always be the most acceptable.

Nearly thirty years ago Mr. Gosse gave lectures on his favourite subject, Marine Zoology, and these are still remembered with pleasure by those who attended the lectures at the Midland Institute in Birmingham. He also for several seasons about that time held classes at Ilfracombe and elsewhere, for the practical study of that science, aided by the microscope. What a real treat it must have been to be present at those classes! The writer never had that advantage, but he has had the great privilege of being out collecting with Mr. Gosse two or three times on the south coast of Devon. To see him encased in high waterproof boots, with hammer, chisel, net, and collecting bottle in hand, wading through the retiring waves at low water, exploring every crevice in the limestone rock, and turning up from its weed-fringed surface a lovely *Eolis amethystina* (one of the Nudibranchiate Mollusca), or other delicate organism, holding it up to the light in his collecting bottle, examining it with the lens, and enthusiastically dilating upon its anatomy, physiology, and æsthetic beauty, was an event to be remembered during a lifetime. He knew everything that came in our way from the algæ up to the fishes.

Not the least among many special characteristics was his ever generous kindness and encouragement to young Naturalists. The writer of these lines owes him a deep debt of gratitude for kindly help in Marine Zoology and the

Aquarium. He also took much interest in our local Natural History Society, and frequently sent us copies of his papers. No member who ever asked him for information could complain that his questions were not promptly and exhaustively answered beyond his anticipation. The pages of this journal are enriched by two or three papers by him, notably one in volume 2, 1879, on "A Marine Aquarium." In his latter years he was a famous grower of orchids, long before they became popular, and his collection at Marychurch was at one time quite unique. He once told the writer that he had specimens, some of which flowered for a day only, and some which continued to flower for a whole year. Mr. Gosse wrote an exquisitely neat and beautiful hand, altogether of the old style, when letter writing was an accomplishment. There is a letter to the writer, dated 14th January, 1879, wherein he expresses kindly sympathy with our town in the great loss it had sustained from the destruction of the Free Library by fire. He says: "I have seen in yesterday's *Times* the terrible calamity which has befallen your valuable library, but I shall be thankful to get the fuller details, which you kindly promise to send me."

A new race of Naturalists and Thinkers has appeared since Mr. Gosse did most of his work—

> "The old order changeth, yielding place to new,
> And God fulfils himself in many ways,
> Lest one good custom should corrupt the world"—

a race which marches under the banner of Evolution, with which Mr. Gosse had no sympathy, and who are represented by Darwin, Herbert Spencer, Huxley, Ernst Haeckel, and others. To the older race, the practical Naturalists, "who hewed the wood and drew the water," and thus furnished many of the data which enabled these eminent philosophers of the new race, in addition to their own good work, to generalise on the results;—to the older race, which includes Bell, Bowerbank, Alder and Hancock, Forbes and Hanley, Gwyn Jeffreys, Yarrell, and others, belongs Mr. Gosse, marching in a no less honourable company. Wherever Marine Zoology is studied, for many a long year to come, the name of Gosse will be a household word. A thoroughly good man, a courteous gentleman, a sincere friend, and a profound Naturalist—what an example to follow!

Mr. Gosse leaves a widow and an only son to deplore his loss. His son (Mr. Edmund Gosse), who inherits his father's gift of language, has already won lasting laurels in other walks of literature. W. R. H.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 281.)

The next step in our history takes us to the neighbourhood of Birmingham, where the parishes of Yardley, King's Norton, and Northfield, which occupy the north-east angle of Worcestershire, adjoin on the south the borough of Birmingham and county of Warwick. The hamlet of Balsall Heath in King's Norton parish is, at its most northerly point, within a mile of the centre of the town; south of it is the hamlet of Moseley. About a mile to the south-east of Moseley Church, but in the parish of Yardley, was an open tract of common, partly covered with bog, called Moseley Common, the remnant of a still larger tract, known as Moseley Wake Green. It produced some of the rarest plants in the county, such as Drosera rotundifolia, Radiola millegrana, Hypericum elodes, Parnassia palustris, Carduus pratensis, Vaccinium Oxycoccos, Menyanthes trifoliata, Scutellaria minor, Anagallis tenella, Centunculus minimus, Narthecium ossifragum, Rhyncospora alba, Eriophorum vaginatum, Osmunda regalis, Lycopodium Selago. The Commons Preservation Society not being at that time in existence, the Common was enclosed and drained in or about the year 1842, and all its characteristic plants destroyed.

It is strange that none of the above species, with the exception of Osmunda regalis, were noticed at Moseley by Withering, although the Common was within three miles of his house. We are indebted to the late Dr. William Ick, Curator of the old Philosophical Institution of Birmingham, for the first notice of Moseley plants. It is contained in a paper entitled "Remarkable Plants found growing in the vicinity of Birmingham in the year 1836," published in "The Analyst," Vol. VI., 1837, pp. 20-28. Miss Mary Anne Beilby, the present Mrs. Avery, of Edgbaston, who commenced the study of Botany under the guidance of the late Mr. Edward White Benson, the father of the present Archbishop of Canterbury, was a frequent visitor to Moseley Common in the years 1835 and 1836. She drew up a list of plants, which was contributed by Mr. Benson to the same volume of "The Analyst" as that above referred to, where it will be found at pp. 293-296. The list may be easily overlooked, as it is not noticed in the index. A further list by Dr. Ick was sent to the *Midland Counties Herald* on the

5th August, 1838. This contains, among others, some plants from the neighbourhood of Stourbridge, and many of Miss Beilby's records are repeated. A few additional Moseley plants are contained in a list by Mr. Samuel Freeman, dated October, 1841, published in the "Phytologist" for July, 1842, 1st Series, Vol. I., p. 261, and a few others in Edward Newman's list of Worcestershire ferns, "Phytologist," March, 1843, Vol. I., pp. 512-514. It may be concluded from the last two lists that the Osmunda was growing at Moseley at least as late as 1841.

In analysing these lists there is some difficulty in distinguishing the Worcester records from those of Warwick. A locality frequently mentioned is Vaughton's Hole. This was in Warwick, close to the edge of the borough, and is now entirely covered with houses. A footpath, with two branches, led from it in a southerly direction, through meadows on the Worcester side of the River Rea, across Edgbaston Lane to Cannon Hill on the one side, and to Moseley Hall on the other. Many plants are noted from Edgbaston Lane and Avern's Mill. The former is in both counties, the boundary running along the Rea, which has two branches crossing the lane, Avern's Mill standing between them in the county of Warwick.

In the following extracts from the lists above mentioned, the Worcester records only have been selected, together with the few others possibly belonging to the county, or very near the border.

WILLIAM ICK, PH.D., "THE ANALYST," VOL. VI., 1837, PP. 22-28.

* **Ranunculus hederaceus.** Meadows near Vaughton's Hole. This plant, though rare in some localities, is very common around Birmingham. (*Probably in Worcester.*)

* **Corydalis lutea.** On an old wall in Edgbaston Lane.

* **Cardamine amara.** Edge of a stream in a meadow near Moseley Park.

* **Reseda Luteola.** Plentiful among the coal pits, near the road side, between Oldbury and Dudley.

Cerastium aquaticum. On rubbish near Moseley Park.

* **Malva moschata.** Edgbaston Lane, opposite the gates of Moseley Park.

* **Hypericum pulchrum.** Meadow near Moseley Park.

* **H. quadrangulum.** Same place.

* **Linum catharticum.** Moseley Common.

* **Genista tinctoria.** Meadow near Selly Hall Park.

Tormentilla reptans (*Potentilla procumbens*). Edgbaston Lane, near Avern's Mill. (*Possibly in Worcester.*)

* **Alchemilla vulgaris.** A meadow about 500 yards beyond Vaughton's Hole, crossed by a footpath to Moseley Park.
* **Sanguisorba officinalis.** Same locality as the preceding; common in meadows on the Edgbaston side of Birmingham.

Epilobium parviflorum. Near King's Norton.

Œnanthe fistulosa. Brook side, Yardley.

* **Torilis infesta.** Near Oldbury.
* **Valeriana dioica.** A meadow about 500 yards beyond Vaughton's Hole, crossed by a footpath to Moseley Park.
* **Carduus eriophorus.** Grounds near Dudley Castle.
* **Tragopogon pratensis.** New road to King's Norton, 3 miles from Birmingham.
* **Conyza squarrosa.** Near Dudley Castle.
* **Chlora perfoliata.** The grounds about Dudley Castle.
* **Atropa Belladonna.** Left hand side of the court yard of Dudley Castle, close to the wall, August 3rd, 1835; July 26th, 1836.
* **Linaria Cymbalaria.** On the ruins of the keep at Dudley Castle.
* **Veronica Anagallis.** Swampy ground near the bridge at Yardley.

Galeopsis Tetrahit. In the Halesowen Road.

* **Echium vulgare.** Plentiful on the ruins of Dudley Castle.
* **Lysimachia nemorum.** In a meadow near Moseley Park.

‡ **Polygonum amphibium.** In the stream midway between Avern's Mill and the Pebble Mill, Edgbaston. *This habitat is in the county of Warwick, very near the Worcester boundary.*

* **Juncus bufonius.** A damp lane between Stirchley Street and King's Norton.

J. lamprocarpus. In the same place as the last.

* **Butomus umbellatus.** The brook in Edgbaston Lane near Avern's Mill. (*Possibly in Worcester.*)
* **Scirpus sylvaticus.** Side of the brook nearly opposite Avern's Mill, Edgbaston Lane. (*Possibly in Worcester.*)
* **Blechnum boreale.** Moseley Common, near the new road.

Miss Mary Anne Beilby, "Analyst," Vol. VI., 1837, pp. 294-296.

Communicated by E. W. Benson. Previous records by Dr. Ick omitted.

* **Thalictrum flavum.** Meadows near the Rea. (*Possibly in Worcester.*)
* **Fumaria capreolata.** Sandy lanes. (*Possibly in Worcester.*)
* **Coronopus Ruellii.** Lanes near Yardley.
* **Viola palustris.** Bog on Moseley Common.
* **Drosera rotundifolia.** Bogs on Moseley Common.
* **Dianthus deltoides.** Lanes near Moseley, but rare.

† **Arenaria tenuifolia.** Gravelly fields, Yardley. (*I suspect an error.*)

† **Stellaria nemorum.** Field in Hob Lane, Yardley. (*Must be an error.*)

Hypericum elodes. In a drained mill pool on Moseley Common.

* **Linum catharticum.** Balsall Heath.

* **Radiola millegrana.** Moseley Wake Green.

* **Rhamnus Frangula.** Moseley Common.

* **Melilotus officinalis.** Fields near Moseley occasionally.

* **Ornithopus perpusillus.** Moseley Wake Green.

* **Potentilla Comarum.** Pool on Moseley Common.

* **Lythrum Salicaria.** Hay Mill Brook, Yardley.

Myriophyllum spicatum. Rea, near Vaughton's Hole. (*Possibly in Worcester.*)

* **Saxifraga granulata.** Lanes near Yardley.

* **Parnassia palustris.** Bogs on Moseley Common.

* **Hydrocotyle vulgaris.** Moseley Wake Green.

* **Helosciadium inundatum.** Moseley Wake Green.

* **Silaus pratensis.** Field in Hob Lane, Yardley.

* **Cnicus** (*Carduus*) **pratensis.** Moseley Common and field in Hob Lane.

* **Serratula tinctoria.** Near the Rea, Balsall Heath.

* **Pulicaria dysenterica.** Common at Yardley.

Eupatorium cannabinum. Yardley.

* **Condrilla** (*Lactuca*) **muralis.** Stony Lane.

* **Senecio sylvaticus.** Lanes, common. (*Probably in Worcester.*)

* **Oxycoccos palustris.** Bog on Moseley Common.

* **Erica Tetralix.** Moseley Common.

* **E. cinerea.** Moseley Common.

* **Menyanthes trifoliata.** Pond on Moseley Common.

* **Veronica scutellata.** Moseley Wake Green.

* **Pedicularis palustris.** Bog on Moseley Common.

* **P. sylvatica.** Lanes near Moseley.

* **Melampyrum pratense.** The Beech Woods. (*Probably at Warley.*)

* **Mentha gentilis.** Yardley.

Stachys arvensis. Yardley-field.

* **Nepeta Cataria.** Yardley.

* **Scutellaria galericulata.** Pond on Moseley Common.

* **S. minor.** Bog on Moseley Common.

* **Anchusa sempervirens.** Near Moseley Hall.

* **Anagallis tenella.** Bog on Moseley Common.

* **Centunculus minimus.** Moseley Wake Green.

* **Plantago Coronopus.** Moseley Wake Green.

* **Polygonum Bistorta.** Lane from Cannon Hill to Moor Green.

* **Triglochin palustre.** Meadows near the Rea.

* **Colchicum autumnale.** Common in wet fields near Yardley.

* **Narcissus Pseudo-narcissus.** Fields near Yardley.

* **Allium ursinum.** Fields and brook sides near Moseley and Yardley.

* **Narthecium ossifragum.** Bog on Moseley Common.

Rhyncospora alba. Bogs on Moseley Common.

* **Eriophorum vaginatum.** Bog on Moseley Common.

* **E. angustifolium.** Bog on Moseley Common.

* **Carex vulpina.** Shady lanes. Common.

* **C. stellulata** Moseley Common.

* **C. remota.** Moseley Common.

* **C. ovalis.** Moseley Common.

* **C. flava.** Moseley Common.

It is doubtful whether the type or the var. lepidocarpa is intended here.

C. binervis. Moseley Common.

C. præcox. Moseley Common.

C. panicea. Moseley Common.

C. cæspitosa (*Goodenovii*). Moseley Common.

* **C. sylvatica.** Edgbaston Lane, opposite Cannon Hill gates.

C. lævigata. Moist field at Highgate, not far from the Rea. *Possibly in Worcester.*

* **C. Pseudo-cyperus.** Ditch in a field on the Balsall Heath side of the Rea.

C. vesicaria. Pond on Moseley Common.

C. acuta.
C. paludosa.
* **C. riparia.**
} Bank of the Warwick Canal. *Possibly in Yardley and Worcester.*

Molinea cærulea. Moseley Common.

* **Melica uniflora.** Common in shady lanes.

* **Asplenium Adiantum-nigrum.** Green Lane, Yardley.

* **A. Trichomanes.** Green Lane, Yardley.

* **A. Ruta-muraria.** Old walls, Hall Green, but not common.

* **A. Filix-fœmina.** Lanes. Common.

* **Scolopendrium vulgare.** Lanes near Yardley. Occasionally.

★ **Aspidium lobatum.** Yardley.

Var. of A. aculeatum.

* **A. Oreopteris.** Moseley Common.

† **A. cristatum.** Moseley Common.

I suspect an error for A. spinulosum.

* **A. dilatatum.** Moseley Common.

* **Osmunda regalis.** Moseley Common.

Lycopodium Selago. Bog on Moseley Common.

(To be continued.) xii 66

A CHAPTER IN THE PHYSICAL GEOGRAPHY OF THE PAST.

PRESIDENTIAL ADDRESS GIVEN TO THE BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

BY HORACE T. BROWN, F.G.S., F.I.C., F.C.S.

(Concluded from page 287.)

Thus we see all the evidence is in favour of the comparative stability of the land areas in Carboniferous times, and the gradual bending down of the floor upon which the sediment was deposited.

I have now given you a condensed account of the leading facts connected with the laying down of the materials forming the Carboniferous Rocks of this part of Europe, and have shown you how the record of the conditions prevailing during their deposition is written in indelible characters in the rocks themselves.

My sketch would, however, be incomplete if it did not include some reference to the agencies which have upheaved these once horizontal strata, and have brought them into the elevated position which they now occupy in the hill country of Northern England.

We have already seen how, in the Pennine Range of hills, the rocks composing them are now arranged in a series of folds or corrugations. With a difference in degree only we always find this tendency to ridge and furrow arrangement in all strata which have been in any way disturbed, but it attains a maximum of development in mountainous districts, where the disturbing forces have been great; the folds, in such cases, assuming great height, and bending on themselves in a very abrupt and remarkable manner.

The more this folded structure of the earth's crust is studied the more evident it becomes that it has not been brought about by any subterranean forces acting vertically upwards. We can only find a reasonable explanation of the complicated, and often inverted foldings of mountainous districts, by assuming that the force was a *lateral* one, and that it has ridged up the rocks, just as a piece of paper or a cloth is puckered when it is laid flat upon the table and the fingers pressed upon it with a slight sliding movement.

That nearly all the elevations of old sea bottoms into hills and mountains have been produced by lateral thrust all

geologists are agreed, but on the question as to how that lateral thrust has been brought about there are at least two distinct opinions.

The hypothesis, which has up to recently found most favour with geologists, and which taken by itself perhaps explains the greatest number of observed facts, is the so-called hypothesis of *Secular Contraction*.

That the earth was originally a molten mass, which has gradually cooled from within outwards, is rendered highly probable from certain astronomical considerations; and that its interior has still a very high temperature is indicated both by volcanic phenomena, and by the fact that the deeper we go down the hotter it becomes; the increment of temperature being about 1° Fahr. for every fifty feet of depth. The hot interior or nucleus must still be cooling down by conduction of its heat through the solidified crust and its dissipation into space, and this cooling must also mean *contraction*. There is, consequently, a constant tendency for the interior nucleus to separate itself from the outer and cooler shell, and since it is manifest that the shell cannot stand alone, it must tend by the power of gravitation to adapt itself to the "diminishing circumference of the contracting interior," and in its efforts to do so, great lateral pressure is evoked, which bends, breaks, and ridges the crust along certain lines. Thus, on this hypothesis, have been produced the great lines of elevation of most of our mountain ranges. They may not inaptly be compared with the wrinkles on the skin of a drying apple, for the skin of the apple becomes wrinkled in its efforts to adapt itself to the shrinking interior of the fruit.

We should certainly expect that the elevation of ridges on the earth's surface, if these are to be looked upon as the expression of secular contraction, would take place along the lines of least resistance, where, in fact, the earth's crust is the thinnest; it is, consequently, a little startling at first to find that the great elevations have nearly all taken place where sedimentation has been the *thickest*, and where we might expect the crust of the earth to be the strongest. The difficulty, however, disappears on examination, and for the explanation we will return once more to the Carboniferous strata of the Pennine area. These, as we have seen, were laid down in a great trough which gradually bent more and more downwards as more sediment accumulated in it. Such a great and constantly deepening depression in the earth's surface is called a *geosynclinal*, and in such troughs have been deposited, sometimes to a thickness of miles, the strata which are now elevated in our mountain chains.

As the great geosynclinal bends more and more downwards, the first formed and lowest strata are carried through zone after zone of constantly increasing temperature, which at last is sufficient to melt, or at any rate to soften, the deepest part of the inverted arch. The very keystone of the arch is then gone, and it is unable to withstand the great lateral strains due to the secular contraction of the earth, and forthwith the elevation of the mass begins.

On the second hypothesis, the lateral pressure which has brought about the folds and wrinkles in the earth's crust is attributed to the expansion of the mass of sediment when it is carried into the zones of higher temperature, as the geosynclinal, or great earth trough, bends more and more downwards under the weight of the superincumbent strata. This hypothesis has, within the last year or so, come into more prominence, owing to the appearance of a most suggestive work, by Mr. Mellard Reade, "On the Origin of Mountain Ranges," to which I must refer any of you who may wish to gain further information on the subject.

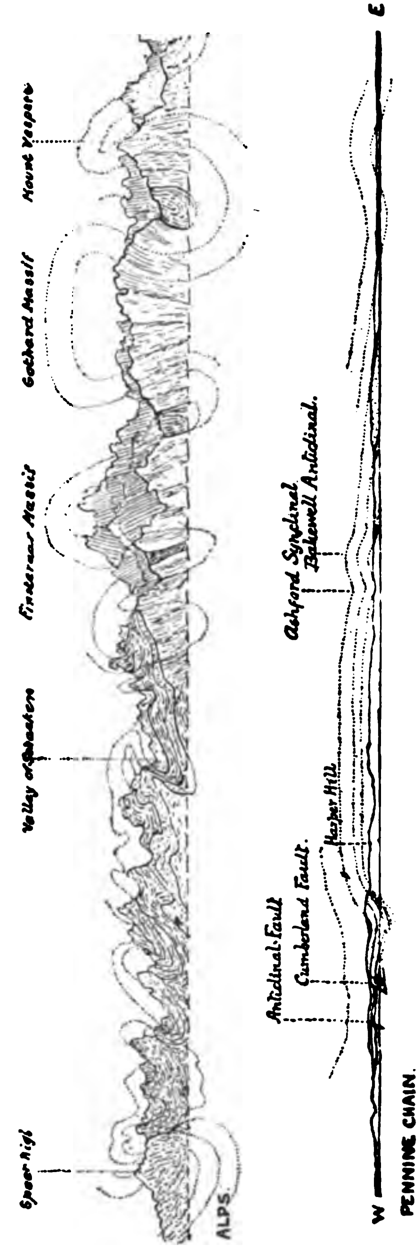
These two theories, framed to account for the upheaval of vast thicknesses of strata deposited on old sea bottoms, are, in my opinion, not so antagonistic as they appear at first sight. I believe that further research will show that *both* agencies, *i.e.*, secular contraction, and expansion of the sediments by heat, have had a hand in the work.

In all highly folded mountainous districts we find that the rocks are bent in such a way as to indicate that the lateral force was exerted more on one side of the elevated region than on the other; that the range in fact exhibits a "shoving" side and a resisting side. Our Pennine Range is no exception to this rule. On its western side, as indicated in our diagram, the corrugations and faulting are much more pronounced than on the eastern side in the colliery districts of North Derbyshire and South Yorkshire, where the inclination of the strata from the centre of the great anticlinal arch is much more even and regular.

In order that you may have a due idea of the proportion of the Pennine folding to that of a lofty range like the Alps, I must refer you to the sections in the adjoining plate, drawn to a true scale of $\frac{1}{180,000}$, both vertically and horizontally.

You may now ask, at what period of the world's history did all this folding of our English Carboniferous Rocks take place?

I need scarcely tell you that geologists cannot reckon by the ordinary standard of years and centuries. They can only refer geological occurrences to certain great periods



HORIZONTAL SECTIONS ACROSS THE ALPS AND THE PENNINE CHAIN, TO A TRUE VERTICAL AND HORIZONTAL SCALE OF $\frac{1}{430000}$.

coincident with the laying down of masses of strata, which for various reasons they are agreed to consider as belonging to one geological age.

The strata which are found succeeding the Carboniferous Rocks in upward succession are known as the *Permian*, and it is manifestly possible, by observing the position of these latter rocks relatively to the underlying Carboniferous, to ascertain if the great earth movements which produced the Pennine Anticlinal were *anterior* to the deposition of the Permian or *subsequent*. If, for instance, we find that the overlying Permian does not participate in the great folds of the underlying rock, or if we find great faults, which it can be shown have resulted from the Pennine upheaval, affecting the Carboniferous Rocks and not the overlying Permian, it is evident enough that the Pennine uplift must have taken place *prior* to the Permian epoch.

Nearly twenty years ago Professor Hull came to the conclusion that the folding of the rocks in the Pennine Chain was of two distinct ages; whilst admitting that the east and west foldings were of pre-Permian age, he contended that the north and south folds must have been produced after the deposition of the Permian. The unsoundness of the latter opinion was shown not very long ago by Mr. E. Wilson and Mr. J. J. H. Teall, who instanced proof, that the north and south flexures must also be considered as pre-Permian. I am inclined to dwell upon this point for a moment, since I think our own neighbourhood affords an opportunity of testing the question, even better perhaps than some of the districts selected by the geologists I have named.

I have stated that the north and south corrugations of the Pennine area may be traced southward into the region of our Ashby Coalfield. Here we have also certain beds which I have recently proved to be of Permian age, and which were evidently not laid down until all the great* north and south earth movements of the Carboniferous period had attained a maximum, thus leading irresistibly to the conclusion that the

* It is too often assumed by geologists that the common arrangement in a disturbed district of folds and faults running at right angles to each other, forming what are known as a *conjugate* series, must have been produced by two distinct acts of lateral compression. It seems to me that the key to these phenomena is to be found in the beautiful experiments of Daubrée on the influence of torsion and pressure upon the fracture of solid bodies, and that conjugate series both of faults and folds are best explained on the supposition of their contemporaneous origin.

Pennine upheaval was entirely pre-Permian. On this subject I may possibly have more to say to you later on in the session.

You may now feel inclined to ask, What is the use of all this? How can a knowledge of the distribution of land and water in a period removed from our day by perhaps millions of years, be of more material service to the human race than, say, a knowledge of the conformation of the continents of Jupiter and Saturn? I would answer that these are all subjects well within the legitimate aim of science, and that her votaries need seldom trouble themselves about the ultimate utility of their discoveries. Let but the work be good, thorough, and honest, no matter whether it be on the structure of the mountains of the moon, the internal economy of a cockroach, or the optical effects of a crystal, the worker may be well assured that his hardly-earned knowledge will some day be put to good account; and in pursuing knowledge for its own sake he has his immediate reward in the ever-enlarging views of the universe and of its great Designer, which are engendered by constant and loving communion with Nature.

It would not, however, be difficult to show a great and immediate advantage to be derived from such enquiries as we have been making to-night, an advantage which I think would satisfy even the most persistent of Utilitarians; for it is evident that upon an accurate knowledge of the original extent and present limits of the various members of the great Carboniferous series of rocks must depend the proper direction of capital in the exploration of the vast mineral wealth they contain, and upon which the material prosperity of our country so largely depends.

Wayside Notes.

The Doctrine of Evolution.—In the "Midland Naturalist" for September, 1887, a letter appeared from Mons. James Grosclande, C.E., of Paris, to Mr. W. R. Hughes, F.L.S., President of the Sociological Section of the Birmingham Natural History and Microscopical Society. It contained the particulars of the formation of a society in Paris for the study of the Doctrine of Evolution and the Science of Society, as set forth in the Synthetic Philosophy of Mr. Herbert Spencer. After an interval of fifteen months a further communication has been received, bringing news that the society is in a

flourishing condition and making good progress. In addition to this, it is gratifying to hear that another has been established on similar lines in New York, under the title of the Brooklyn Ethical Association. The secretary, Mr. James A. Skilton, prior to any definite settlement of their future programme, wrote to Mr. Herbert Spencer, stating what they proposed to do, and asking his approval and advice. This correspondence Mr. Herbert Spencer sent to Mr. Hughes, with the request that he would assist Mr. Skilton with suggestions, and give him an account of the working of the Sociological Section in Birmingam. Mr. Hughes at once complied, and has received the following letter:—

"New York,
"October 8th, 1888.

"Dear Sir,—I was very glad to learn that not only Mr. Spencer but yourself and others were interested in what we are trying to do in behalf of Evolution. Our arrangements are so nearly perfected that we commence on Sunday evening next, October 14th, in accordance with our programme.

"The publications you mention in your letter came duly to hand, and have interested us much, for which please accept my thanks. Mr. Spencer's letter in reply to mine, as well as your own, will be read at the opening of the discussion next Sunday evening.

"Yours truly,
"(Signed) James A. Skilton."

The programme of the Brooklyn Ethical Association is arranged on exceedingly broad lines, and embraces the whole range of Evolution. The various branches are taken, one each evening, in the form of a paper, followed by discussion, in order that a comprehensive view of the theory may be gained. Later on, when this purpose is served, each branch will receive its due attention; the main one, Ethics, always being the point to which their work will tend. It is very encouraging to the student of Sociology to find that the science is gathering adherents in other lands, and that though slowly, the esteem in which it is held is surely gaining ground. We augur good results from the establishment of our brother society in America, and heartily wish it success. Herbert Stone.

Botanical Notes from Stroud.—Among a large number of flowering plants observed in this neighbourhood during the summer months, by some members of the Stroud Naturalists' Club, the following less common plants are here recorded for the purpose of comparison with other districts:—Anemone Pulsatilla, Ranunculus arvensis, Caltha palustris var. Guerangerii, Helleborus fœtidus, Aquilegia vulgaris, Aconitum Napellus, Nasturtium amphibium, Cardamine amara, Diplotaxis muralis, Thlaspi arvense, T. perfoliatum, Stellaria aquatica, Arenaria tenuifolia, Sagina apetala, Althæa hirsuta (as a weed in a garden), Geranium pyrenaicum, G. columbinum, Euonymus

europæus, Pyrus Aria, Saxifraga granulata, Chrysosplenium alternifolium, Bryonia dioica, Sambucus Ebulus, Galium Mollugo, Asperula cynanchica, Valeriana dioica, Dipsacus sylvestris, D. pilosus, Inula Helenium, I. Conyza, Pulicaria dysenterica, Lemna gibba, L. trisulca, Potamogeton densus, Carex digitata, Anthemis nobilis, Senecio erucifolius, Cichorium Intybus, Picris hieracioides, Lactuca muralis, Campanula glomerata, Specularia hybrida, Primula elatior, Lysimachia vulgaris, L. Nummularia, Anagallis cærulea, Cuscuta europæa, Atropa Belladonna, Verbascum nigrum, Linaria Elatine, L. spuria, L. viscida, Lathræa squamaria, Salvia verbenaca, Polygonum Bistorta, Daphne Laureola, Spiranthes autumnalis, Cephalanthera rubra, Orchis Morio, O. pyramidalis, Ophrys apifera, O. muscifera, Herminium Monorchis, Habenaria bifolia, Tamus communis, Convallaria majalis, Fritillaria Meleagris, Colchicum autumnale, Typha angustifolia, Acorus Calamus.—S. J. Coley.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Sociological Section.—Supplementary Meeting, October 4th. The President, Mr. W. R. Hughes, F.L.S., in the chair. Fifteen members present. Mr. W. R. Hughes read his paper on the "Progress of the Doctrine of Evolution during the Past Year," giving an account of the literature that had appeared during that time in connection with the subject, and details of the work done by our own and kindred societies.—Supplementary Meeting, October 18th. Mr. Alfred Browett in the chair. Twelve members present. Miss Byett gave her exposition of the third chapter of the second part of Mr. Spencer's "First Principles," entitled "Space, Time, Matter, Motion, Force," with a resumé of the work of last session necessary to give continuity to the line of reasoning.—Ordinary Meeting, October 23rd. Mr. W. R. Hughes, F.L.S., in the chair. Twelve members present. Miss Davies, who was proposed as a member at a previous meeting, was elected. Mr. Bagnall sent for exhibition, for Miss Gingell, of Dursley, *Hypnum splendens*, *H. rutabulum*, *H. molluscum*, *H. triquetrum*, and *H. squarrosum*. Mr. Grove exhibited *Ag. sulphureus*, from Dawlish; for Miss Gingell, *Ag. spectabilis*, *Clavaria coralloides*, *Craterellus cornucopioides*, *Cortinarius torvus*, *Hygrophorus coccineus*, and *Lycoperdon pyriforme*; for Rev. D. C. O. Adams, *Ag. cartilagineus*, *Cortinarius albo-violaceus*, *Hygrophorus chrysodon*. Mr. Stone read his exposition of Mr. Spencer's essay on the "Ethics of Kant," giving a short criticism of Kant's method, and a brief account of his life and works.—The Annual Conversazione was held at the Mason College, on Tuesday, October 30th. One hundred and eighty-two members and friends were present. Among the objects exhibited were a large number of lantern photographs:—microscopical, by Mr. J. Edmonds; flowers, by Mr. C. Pumphrey; and scenes taken during the meeting of the British Association at Bath (including Stonehenge and Salisbury Cathedral), by Mr. C. J. Watson.

Mr. J. E. Bagnall showed a collection of the rare plants of Warwickshire; and Messrs. Marshall and Pumphrey, a collection of Norwegian plants. Mr Walliker exhibited a fossil stem, Lepidodendron, from the stone used for the new Post Office. An interesting and rare exhibit was a case of half-a-dozen Siberian Sand Grouse, belonging to Mr. R. W. Chase, captured this year; Mrs. E. Hopkins, of Chester, contributed some beautiful cards of birds' feathers, arranged so as to show the various forms found in each species; Mr. J. Heaton exhibited a large albatross, which was much admired. Professor Lapworth honoured the Society by contributing a number of maps, on which were delineated the results of his recent investigations into the Ordovician System of Shropshire. A large collection of fungi was shown by the President, who also, in conjunction with Mr. Bagnall, exhibited some interesting old botanical books. Not the least attractive of the objects shown were a number of reptiles, snakes, &c., and their eggs, all gathered within thirty miles of Birmingham, by Mr. Shrive; Mr. Blakemore contributed a small marine aquarium containing a number of beautiful living sea-anemones. During the evening the President delivered a short address, touching upon the growing importance of the theory of evolution in the life of the world, and the impossibility of becoming a fair judge of it without at least that modicum of biological knowledge which a Natural History Society could impart to its members. The room was decorated with plants kindly lent by Hans Niemand. MICROSCOPICAL SECTION, November 6th. The President, Mr. W. B. Grove, B.A., in the chair. Five new members were proposed. Mr. J. B. Harrison, of Barbados, sent as a present to the Society 5lb. of infusorial earth from the Springfield deposits, some of which were exhibited under the microscope, and promised a good yield of interesting specimens. Mr. W. B. Grove, B.A., exhibited a beautiful clump of *Agaricus rachodes*, an edible fungus, from Sutton. Mr. W. H. Wilkinson, *Usnea barbata* var. *rubiginea*, a rare lichen, collected by Mr. J. N. Dixon, F.L.S., from Dolgelly. Mr. Thos. E. Bolton, *Limnias annulatus*, under the microscope. Dr. Hudson says it is rare; he has only met with it once.—SOCIOLOGICAL SECTION.—Supplementary Meeting, November 11th. The President, Mr. W. R. Hughes, F.L.S., in the chair. Eleven members present. Mr. Hughes read a letter from Mr. J. A. Skilton of New York, announcing the opening of the Brooklyn Ethical Association. Mr. Parkes read the seventh chapter of Mr. Spencer's "First Principles," entitled the "Persistence of Relations among Forces."—BIOLOGICAL SECTION, November 13th. Mr. R. W. Chase in the chair. Five new members were elected. Mr. W. Wilkinson exhibited the rare *Arctostaphylos alpina*, from the Orkneys, and *Empetrum nigrum;* Mr. J. E. Bagnall, for Miss Gingell, a very large and interesting collection of fungi, among which were *Agaricus nudus*, *Ag. fragrans*, *Ag. butyraceus*, *Ag. maximus*, *Hygrophorus pratensis*, &c.; also mosses such as *Dicranum majus*, *D. palustris*, *Hylocomium splendens*, &c., from Dursley, Gloucestershire. For Mr. G. W. Tait, M.R.C.S., the Touch-me-not, *Impatiens Noli-me-tangere*, from Knowle. Mr. R. W. Chase, F.L.S., exhibited a complete series of the British *Corvidæ* (Raven, Jackdaw, Rook, &c.), with most interesting notes on their habits, habitats, and distribution, which called forth a long and pleasant discussion, in which Messrs. W. P. Marshall, M.I.C.E., H. E. Forrest, J. Levick, T. H. Waller, B.A., W. Wilkinson, J. Rabone, and J. A. Panton, F.R.S.E., took part, the latter gentleman giving many personal recollections of special interest. GEOLOGICAL SECTION, November 20th. Mr. T. H. Waller, B.A., B.Sc.,

in the chair. Minutes of last meeting read and confirmed. Election of new member: Mr. T. H. Everton, of Parish Offices, Edmund Street; proposed by Mr. W. R. Hughes, seconded by Mr. W. B. Grove, carried unanimously. Exhibits:—Mr. Waller, on behalf of Mr. Pumphrey, a carnivorous slug, *Testacella haliotidea* (common in France); Mr. Bagnall, for Miss Gingell: *Ag. fragrans*, *Ag. hypnophilus*, *Mycena tenuis*, *Ag. geotropus*, &c., moss, *Pterogophyllum lucens*. Mr. Hughes, for Miss Gingell, from Dursley, specimens of locally called Gibraltar rock, amygdaloidal Trap (vesicular). Mr. W. B. Grove, from Sutton, *Ag. flavidus*. A paper was read by Mr. A. Browett on the "Bath Oolite and the Method of Quarrying it." An interesting discussion followed, in which Messrs. Waller, Chase, Marshall, and Hughes took part. On the motion of Mr. Waller, seconded by Mr. Marshall, a cordial vote of thanks was unanimously given to Mr. Browett for his paper. Mr. Wagstaff exhibited some drawings he had made of Polycystina, from the Barbados earth sent by Professor Harrison; he also exhibited a slide of Polycystina which he had prepared for the microscope.—Sociological Section.- Supplementary Meeting, November 22nd. Mr. W. R. Hughes, F.L.S., in the chair. Seventeen members present, including Mr. Alfred Hayes, formerly Secretary to the Section. Professor Poynting delivered his exposition of the three chapters of Mr. Spencer's "First Principles," entitled "The Indestructibility of Matter, the Continuity of Motion, and the Persistence of Force," in which he stated Mr. Spencer's views with great force and clearness, but disputed the soundness of his premises, and maintained, that, in the absence of experiment, Mr. Spencer's conclusions could not be arrived at by *a priori* reasoning, and that the experimental method was of primary and not of secondary importance. An animated discussion followed in which most of those present took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 22nd. Exhibition of "polarised" objects. A series of objects was shown, including pure and impure cocoa (the latter being adulterated with potato starch), jaw of mackerel, palate of *Trochus*, and a number of objects by Mr. J. Edmonds, with his automatic rotating selenite.—October 29th. The President in the chair. Mr. H. Insley gave a lecture on "Coal and How Mined." After describing at some length the conditions under which a profuse vegetation grew and became water-logged and mineralised, the speaker showed with the aid of a lantern a number of photographs, chiefly of the Hamstead Colliery, those of the underground workings having been taken with magnesium light. They illustrated the difficulties and dangers under which coal was mined, and the various contrivances used to give greater security to life. A vote of thanks to the lecturer closed the meeting.—November 5th. Annual Meeting and President's Address. The following reports were read: the Secretary's, reviewing the work of the year as being very satisfactory; the Treasurer's, that he had a balance of £3 3s. 2d. in hand; and the Curator's; these were received and adopted. On the proposition of Mr. O. Hutchinson, seconded by Mr. J. W. Neville, Mr. T. H. Waller, B.A., B.Sc., was unanimously re-elected President for the ensuing year. Mr. Waller having suitably replied, delivered his address. He said we might advantageously consider what is the object of a society of this kind, and how it could most suitably be followed. His sympathy was not with those who after beginning the study of Natural History spread

themselves out too much. Everyone was the better for a knowledge of natural objects, but it should be the aim of the student to have a definite path. He might sometimes take a bye-lane, but should always come back again. A conchologist would only have interest in Botany as a subsidiary subject, and anyone would find the narrowest subject sufficient for leisure hours. At every meeting there should be something on the edge of what is known. Popular objects interested a meeting, and diffusiveness had its uses, but a special line was the highest development of Natural History. The stock beauties of Nature brought in and interested young members, yet the true object of such study was to find out something more than was already known. After the usual votes of thanks to retiring officers, Messrs. J. Moore and J. Rodgers were unanimously elected Vice-Presidents.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D. At the evening meeting on Wednesday November 21st, the Chairman, Mr. F. T. Mott, F.R.G.S., read a short paper on "The Amphibians and Reptiles of Leicestershire," which was followed by a discussion on the variation of colour in the frog. Mr. E. F. Cooper believed that fear caused a rush of blood to the skin, thus darkening the colour. Mr. Vice thought that frogs were darker when in water than on the land. It was further suggested that they were probably yellower after casting the skin, and that like the chameleon and some other reptiles they had power to vary their colour at will. The Chairman announced the presentation to the Society, for the special use of Section D, of a cabinet containing 100 microscopic slides of British diatoms, admirably mounted and named, the gift of Mr. F. Bates, who was now unable to attend the meetings of the Section, but desired to express his continued interest in its welfare. The following resolution was moved by Mr. E. F. Cooper, seconded by Dr. Cooper, and carried unanimously:—"That the members of Section D present their cordial thanks to Mr. Bates for his very handsome and valuable gift, and are much gratified to learn that he will remain a member of the Section." The next business was an exhibition of ferns—British and foreign—a number of very interesting collections being displayed, viz.: By Dr. Cooper, fresh fronds of about 20 foreign species; by Mr. Turner, dried specimens of South African and of remarkable varieties of British species; by Mr. Vice, a collection of British species; by Mr. E. F. Cooper, a large collection of British specimens and of foreign ferns mostly grown by himself; by the Chairman, a number of the rarer British ferns, and several series showing the development from the spore; by Mr. J. T. Thorpe, a very fine collection of dried fronds, mostly grown by himself, and mounted on sheets of elephant-folio size. By comparison of the different exhibits much information was gained, and many specimens identified which were previously unnamed. Mr. Grundy then exhibited a living specimen of the curious and rare slug, *Testacella mangei*, which burrows in the soil, feeding upon earth-worms. This specimen was found near Bristol. The Chairman exhibited a specimen of the rare fungus *Geaster Bryantii*, found near Leicester, and some large examples of the very destructive dry-rot fungus, *Merulius lacrymans*, in several stages of its development.

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EDITED BY
E. W. BADGER & W. HILLHOUSE, M.A., F.L.S.

"Come forth into the light of things,
Let nature be your teacher."
Wordsworth.

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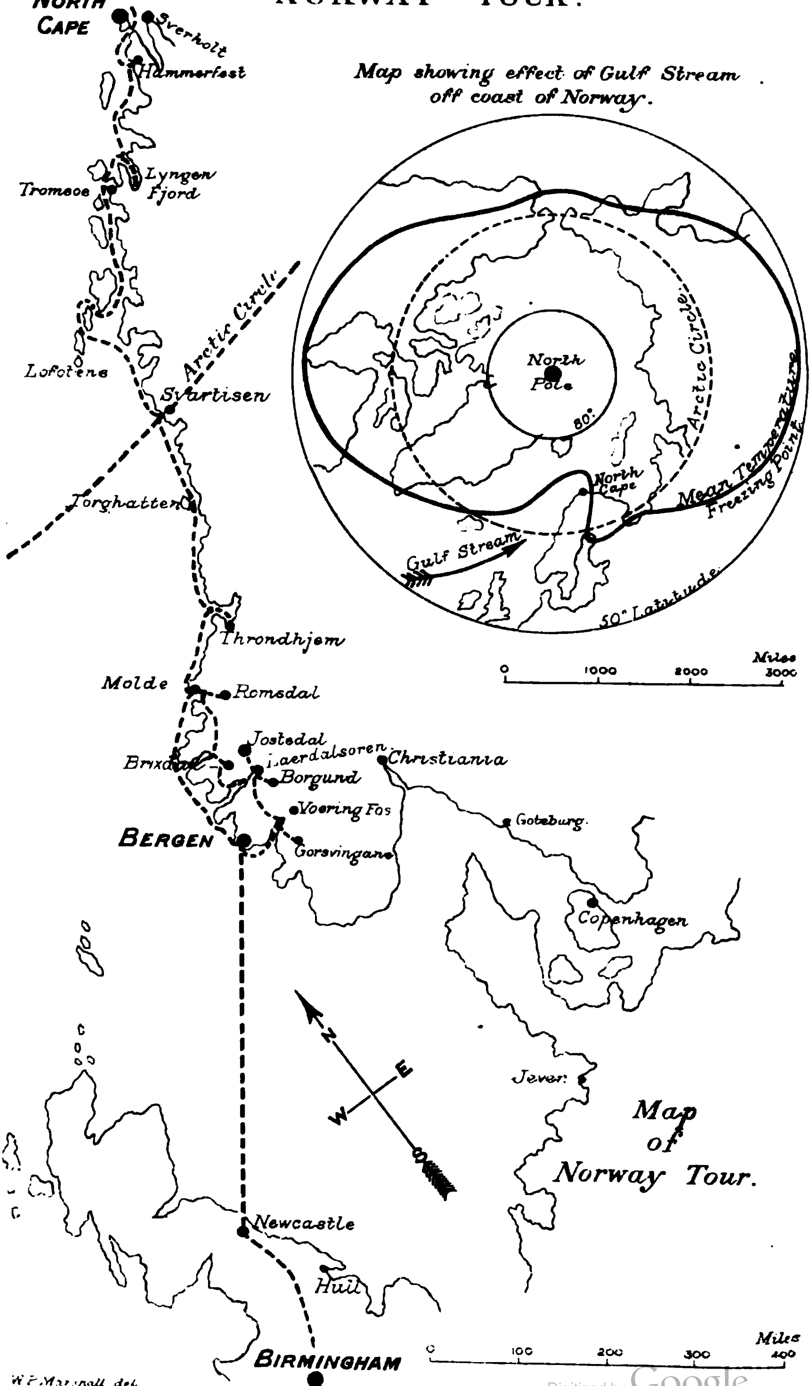
ILLUSTRATIONS IN VOLUME XII.

PREFACE.

At the end of the twelfth year during which this magazine has been regularly issued, we have once more the pleasing duty of thanking our contributors for their valued help. The only cause for regret is that more of the midland Natural History Societies do not make use of our pages for the publication of more of the important papers read before them. The Members of one of these Societies—the Oxford Natural History Society—have been especially helpful to us during the past year, and have supplied us with several most interesting contributions. We trust the Members of other Societies will follow their example, and so add to the interest of our next volume, for which we are glad to announce that we have already received several papers of general interest.

INDEX.

NORWAY TOUR.



W. P. Marshall del.

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THE MIDLAND NATURALIST.

"Come forth into the light of things,
Let Nature be your teacher."
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NOTES ON A TOUR IN NORWAY AND COLLECTION OF PLANTS.*

BY W. P. MARSHALL AND C. PUMPHREY.

This tour was a six weeks excursion to Norway in the present summer, from the 26th of June to the 6th of August; the route taken was direct to Bergen and the North Cape (nearly 2000 miles distance from Birmingham) followed by a three weeks land journey, as shown in the map in Plate I. The sea passage to Norway was taken from Newcastle to Bergen by the "Norge" steamer, a thirty-six hours run; starting on Tuesday evening and arriving at Bergen on Thursday morning, and then going forward the next day by the fine North Cape tourist steamer "Olaf Kyrre," with a party of about sixty fellow passengers.

On the way to the North Cape there was a stay on shore at several places. First at Throndhjem, the ancient capital of Norway, where the very interesting old cathedral was visited, which is in process of restoration.

Then Torghatten was visited, an island rock that has a remarkable natural archway through the entire rock, which was reached by a half-hour's scramble up the side, and gave a striking view through the large archway of the sea and numerous islands beyond.

The Lofotens were next visited, islands out in the open sea, a couple of hours steaming from the main land, with magnificent jagged mountains forming a continued panorama of striking and beautiful outlines, with a range extending over 100 miles. We passed round one of the islands, returning by a narrow channel between two of them, the Raftsund, which is specially fine in scenery. The passage onwards to the North Cape, like much of the previous voyage, was almost

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*Read before the Birmingham Natural History and Microscopical Society, October 9th, 1888.

continuously between rocky islands and the main land, presenting a constant variety of fine scenery.

Tromsoe was stopped at for a day, and the party took a two miles excursion from there up Tromsoedal to visit a Lapp encampment, where a herd of 200 reindeer was seen, the visitors going about amongst the reindeer and the Lapps.

The Midnight Sun was seen the first time on 4th July, the night before getting to Tromsoe; the steamer anchoring in a position clear of the islands before midnight, for the purpose of giving the party the anxiously expected sight.

Hammerfest was visited on Friday morning, 6th July, and the same night we were on the top of the North Cape viewing the Midnight Sun again, a week from the time of leaving Bergen. The ascent is an hour's walk from the ship; first a steep zig-zag climb of 800 feet, and then a mile walk to the summit, 950 feet high. The North Cape is on an island named Mageroe, which we sailed round.

The Svaerholt Bird-rock, near the North Cape, was visited previously; it is a great rock rising abruptly out of the sea, 1200 feet high, covered with enormous numbers of birds which suddenly, on the firing of a cannon, fill the air overhead with a white cloud like a heavy snowstorm.

Lyngen Fjord was visited on the return, the steamer going up the fjord and back again, a two hours trip, for the sight of the fine jagged mountainous rocks, with picturesque glaciers.

The great Svartisen glacier, which is just at the Arctic Circle, was visited; the party landed in boats, and scrambling over the half-mile of old moraine that lies between the foot of the glacier and the sea, were then able to get a little way on to the glacier.

We left the North Cape steamer at Molde, a day's sail short of Bergen, and then started on a three weeks inland trip to the celebrated Romsdal, with its great Romsdalshorn and Troll-tindern towering up to more than 5000 feet height, one on each side of the valley; the Geiranger Fjord and Brixdal glacier; up Sogne Fjord to Laerdalsoren and Borgund, up Jostedal to Nigaards Brae glacier, through Naero Fjord and Naerodal to Vik and Voering Fos, and then on to Odde, Buer Brae glacier, and Gorsvingane Pass, 3400 feet height above the sea. Then by the Hardanger Fjord to Bergen, and back to Newcastle.

A special charm in this trip was the sight of the waterfalls. Norway is truly called the country of fjords and waterfalls (Fos); the fjords with their grand and continually varied scenery, and the innumerable waterfalls of most charming variety, including a large number of great size.

During this inland trip, and at the various stopping places of the North Cape steamer, we had opportunities for collecting plants: we were much struck with the active condition of the vegetation, especially in the leaves of the trees; and the country was quite a wild garden of flowers, many British plants being met with in unusual luxuriance of growth. This is due partly to the mild climate caused by the Gulf Stream, which impinges on the whole coast up to the North Cape. The temperature on the North Cape at midnight was as high as 55°, although it is within 19°, or only 1300 miles, distance from the North Pole; and at Hammerfest, which is the most northern town in the world, the temperature was actually 70° in the shade at midday.

The effect of the Gulf Stream is shown upon the circumpolar map in Plate I., in which is given the temperature curve of 32°; or the curve passing through all the localities in which the mean annual temperature is the freezing point, the winter averaging as much below the freezing point as the summer averages above it. This curve reaches nearly as low a latitude as 50° in the two great continents of Asia and America, being there at about the latitude of the South of England; but the gigantic warming effect of the Gulf Stream indents the curve past England and the coast of Norway, to a point actually 600 miles north of the Arctic Circle, although the curve is 1000 miles south of the Arctic Circle in the continents of Asia and America. This causes the remarkable and exceptional mildness of climate of the whole coast of Norway up to the North Cape, as well as of the west coast of the British Isles.

The great exciting cause however of the active condition of the vegetation, is the continuous sunlight that is day and night acting upon the plants: their development is never checked by the darkness of night, and there is the continuous stimulus of sunlight all through the summer. At the North Cape itself, the sun never sets for 2½ months, from 11th May to 30th July, and in the other less northerly positions within the Arctic Circle the sun is so little below the horizon for any portion of that time, that there is practically continuous daylight throughout the 2½ months.

In our trip we had the sun continuously above the horizon for six days and five nights, and were so fortunate as to see the Midnight Sun on four successive nights. At the North Cape at midnight the sun was about eight diameters above the horizon, when we were there on July 6th, and it was shining brilliantly, with a light about equal to the light that we have usually on autumn afternoons in this country. Measured actinically, the light at midnight was found to be equal to

one-fifth of the photographic power ot the average midday sun in England.

Of the Plants collected, one of the most interesting is *Cotula coronopifolia*, a composite plant that is very limited in Europe, and is found in only one locality in Norway, on marshy ground at the head of a sea fjord, 90 miles distant from the open sea. Its home is considered to be the Cape of Good Hope.

Another local plant, *Aconitum septentrionale*, a large Monkshood belonging specially to Norway and Sweden, was found plentifully distributed over the country, and in Romsdal were found very fine specimens, one measuring 6ft. in height, with leaves 21ins. across, and flowers 1½ins. long.

On the North Cape itself, several Swiss plants were met with, and specimens of many British plants, including:—*Saxifraga oppositifolia*, *Loiseleuria procumbens*, *Silene acaulis*, *Dryas octopetala*, *Arabis alpina*, *Saxifraga cæspitosa*, &c. *Saxifraga cotyledon* was found very generally throughout the country, with fine bunches of flowers standing out from ledges in the rocks in many districts.

The beautiful heaths, *Andromeda polifolia* and *Menziesia cærulea*, were found in many places, and the delicate fern, *Woodsia ilvensis*, was particularly luxuriant in growth. *Eriophorum latifolium*, the large Cottongrass, was very abundant, and attained a remarkably large size in its cotton tufts; the smaller Cottongrass, *Eriophorum alpinum*, was also found at Nigaards Brae in Jostedal.

Mulgedium alpinum, the blue Sow-thistle, was found at one place near Voering Fos. and *Arnica montana* was seen in rich orange masses in the meadows in one district. *Viola tricolor* and *Alchemilla* were specially abundant, also *Saxifraga Aizoides*.

A novel position for plants was on the roofs of the houses; the roofs generally throughout the country, including the majority of the houses in the smaller towns, are covered with turf, on which is an abundant crop of vegetation; grass, plants, and shrubs, and even small birch trees eight or ten feet in height are frequently seen in the country growing upon the roofs. At Hammerfest we actually saw a couple of kids grazing on the roof of a house. The houses are really roofed with birch bark, which is laid on in many layers, like thatching with straw, up to a total thickness of about four inches, and is then completely waterproof; and, to prevent the bark getting blown away, it is covered with a thick layer of turf, which grows together and forms a complete protection, the roof appearing to last, without requiring repair, until the house goes

to decay. The houses are constructed entirely of wood, excepting the chimneys, which are stone.

The plant *Cotula coronopifolia*, that was first referred to, is a rare object about which there is a history of much interest in connection with the migration of plants. We found it at the only site where it is known to exist in Norway, Laerdalsoren (see map, Plate I.); and this was shown to us by Professor Lindman of Upsala University, Sweden, who has since kindly sent us further information on the subject, and a reference to the "Botanische Zeitung" for January 17th and 24th, 1862, which contains a careful detailed account and history of the plant by Dr. Buchenau.

This plant was first found in Europe, a century and a half ago, in 1739, by Moehring of Jever in North Germany (see map), near the coast, between Denmark and Holland, and he at first supposed it to be *Matricaria maritima*.

The plant was next recorded in 1767, as found at Neuenburg in the same district, on the high road, where rainwater accumulated and the spray from the sea reached; and also on the coast of Jahde Bay, near Jever, where Moehring had lived. Then in 1788, Ehrhard of Neuenburg, and subsequently other botanists found the plant in that district, and also along the Weser River, in several places all exposed to the spray from the tide.

In the next century, in 1852, Schloeter found the plant again in the same locality, and it also grows now in Nordeney Island, off the coast between Jever and Emden; but in 100 years it has only been found to have spread itself to a few other places in the province.

It has occurred also in Sweden on a small spot in Bohuslan, near Goteburg (see map), but there are now no more traces of the plant to be seen in that place. It is recorded in Spain in 1852, by Willkomm, and in Portugal, in 1855, by De Candolle, and is also named as having been found in Candia.

The original home of *Cotula coronopifolia* is considered to be the Cape of Good Hope, but it has also been found in Egypt, in Australia, Tasmania, and New Zealand; and in South America, in Brazil, Monte Video and Chili; in all the cases it was found growing in low lands near the seashore, as in Germany. The plant requires a site with short grass, and a soil with a certain richness of soluble salt, although it cannot be called a salt water plant. The Norway locality in which we found it, Laerdalsoren, is a low marshy ground at the head of one of the long sea fjords.

As regards the migration of this plant, it may be noticed that all the localities where it has been found in Germany, Sweden, and Norway, are on the West coast, exposed to the influence of the Gulf Stream; and the flower is a composite with winged seeds, which admit of being carried long distances by an ocean current.

(To be continued.)

THE FOUNDATIONS OF OUR BELIEF IN THE INDESTRUCTIBILITY OF MATTER AND THE CONSERVATION OF ENERGY.*

A CRITICISM OF SPENCER'S "FIRST PRINCIPLES,"

PART II., CHAPTERS IV., V., AND VI.

BY J. H. POYNTING, D.SC., F.R.S.

I confess that when I accepted the invitation to give a paper on the chapters in Spencer's "First Principles" dealing with the Constancy of Matter, Motion, and Force, I had no idea of the difficulty of the task which I was undertaking. I remembered that when, many years ago, I read the chapters I disagreed with their general drift, and I thought it would be tolerably easy to disagree still. And so I have found it. But it is one thing to disagree with an author, and quite another thing to give clear reasons for your disagreement, especially when the subject is so difficult and your author is so great a master of argument as Spencer. And there is to me another difficulty in that I have never studied Spencer's system as a whole. The chapters I am to deal with form but a part of that whole; one staircase, as it were, in a grand edifice, which you have watched building stone by stone. I am venturing to criticise this particular staircase when I have not studied the plans of the building, and know not whence it springs or whither it leads. I am a mere carpenter venturing to criticise the work of a great architect. I don't know that I am even a carpenter. I have been, for many years, especially engaged in teaching people how to climb this particular kind of staircase, and perhaps you may think that that is hardly a

* Read before the Sociological Section of the Birmingham Natural History and Microscopical Society, November 22, 1888.

sufficient warrant for a criticism of the nature of its materials and the strength of its supports. But this is the task I have undertaken.

If I may assume that you are acquainted with Spencer's argument, I need only briefly sum it up as follows :—

In Chapter IV. he maintains that the indestructibility of matter is a necessary truth, one of which we cannot imagine the contrary when we once clearly present to our minds the meaning of the terms "matter" and "indestructible." He argues that the so-called chemical and physical proofs based upon weighings really assume the principle in assuming that the weights used to counterpoise are constant in their value. He concludes that, when analysed, the indestructibility of matter is found to mean the persistence of force. For if we use the chemical proof, the constancy of weight means persistence of gravitative force, and, if we regard the principle as a necessary truth, we again come to persistence of force, for it is by force that we really know matter.

In Chapter V. it is argued that the continuity of motion is a truth of the same order, one of which we cannot imagine the contrary. When we contemplate a swinging pendulum, and note the recurring appearance and disappearance of its motion, we cannot suppose that that of which the motion is a sign has been annihilated when the motion ceases at the end of a swing. We must suppose that there is a *continuous existence* now shown by the motion, and now by the pull down which we feel if we hold the pendulum in its highest position. This existence we think of as the objective correlative of muscular effort; we think of it in terms of force. Again, if a moving body is gradually brought to rest, it is stopped by force exerted by some other body or bodies upon it, and this retarding force has a reaction on the acting bodies, handing on to them the motion lost by the body as it slackens speed. Again we think of the motion being communicated by force. If we seek to prove the continuity of motion, our so called proofs really assume the persistence of force in some form or another, either in the constancy of the masses concerned, or in the constancy of the measuring instruments used. Hence we again come to the same foundation as that on which the indestructibility of matter is built, viz:—the persistence of force.

Having concluded that the indestructibility of matter and the continuity of motion ultimately imply the persistence of force, Spencer proceeds, in Chapter VI., to examine the warrant we have for the truth of this last doctrine. He asserts that all our measures assume it, and that therefore we

cannot by experiment prove it. We cannot show that it rests on any other truth. All reasoned out conclusions must rest on some postulate. We go on merging derivative truths on wider and wider truths, until at last we reach a widest truth which can be merged in no other or derived from no other. And whoever contemplates the relation in which it stands to the truths of science in general will (he says) see that this truth transcending demonstration is the persistence of force.

It is remarkable that so calmly and closely reasoned an argument should have excited so much heat as this has done in certain physicists: all the more remarkable in that physicists have not, for the most part, closely examined the foundations of their great generalisation for themselves, have not clearly realised what is the result of experience and what is metaphysical assumption. Perhaps it is from this very neglect of the subject that some of their bitterness towards Spencer has arisen. It is not pleasant to have a stranger coming in to set one's house in order. But there is, I think, another reason. The physicists have by toilsome steps been pushing into a hitherto unknown country; they have been drawing careful maps describing the details of its features as they came to them, and now after putting together the results obtained by generations of explorers, they have found the course, as it were, of the great mountain ranges and rivers. But Mr. Spencer seems to say that after all they need not have toiled so much. From the border of the country the general lie of the strata might have been made out, and it might have been seen that the mountains and rivers could not run otherwise than they do. And indeed all their survey depended on a base line at the border; all the boasted measures were but in terms of that base line, so that all their maps were but repetitions of it. It is always irritating to be told that if you had only kept your eyes open you might have saved your pains. An implication of unwisdom is always the direst insult.

But after all, Mr. Spencer may not be right. For my own part, I share the view of the physicists, that his arguments are to a great extent unsound. I hold that the field of science cannot be mapped with certainty from its borders, and that our knowledge of its main features is due solely to the explorers. Further, in that these explorers are fallible, I hold it possible that their maps may be wrong, at least to some extent, and that future generations may show that we have been too hasty in assuming that we knew even the position of the main features.

Were I to criticise Mr. Spencer's statements point by point, there would be danger that we should be confused by differences about mere details. I propose therefore to state my own beliefs in these matters, and to give as far as I can what I consider the warrant for them.

The main work of the physicist is the investigation of the resemblances or similarities which he observes in phenomena. The description of these resemblances he embodies in physical laws. For instance, he observes that bodies resemble each other in falling to the ground when no other body intervenes; that they resemble each other in remaining at rest unless there is some other body to whose presence their motion can be ascribed; that they resemble each other in that they require an effort from him to set them moving, an effort which he feels through his muscular sense; and so on. These are mere qualitative resemblances which can be discovered by simple observation, and every intelligent being has through his own observation, through his early instruction and possibly through the observation of his ancestors, become aware of a number of such resemblances or physical laws which he regards as mere common sense. In fact, in this respect, we are all like Moliere's M. Jourdain—we have been speaking physics these forty years and never knew it. But the physicist, of course, goes far beyond this classification of simple observations. He makes experiments as well as observations. He calls in the aid of instruments and makes measurements; he discovers that phenomena resemble each other in various ways which can be expressed by numerical relations. Let us take an example.

An experimenter puts a piece of rock salt and a vessel of water side by side on the one pan of a balance, and counterpoises them by weights on the other pan. He now powders the salt and finds the weight is still the same; putting the salt into the water and stirring till it is all dissolved, the balance is unchanged. Finally, distilling the liquid and collecting the water and the salt which remain behind, he has them separate, and placing them on the balance, they are counterpoised by the same weight as before. This experiment may serve as a type of all the various weighing experiments, chemical and physical, which are taken as proving the indestructibility of matter.

What conclusions does our experimenter draw? Firstly that the salt was in existence throughout the experiment, and secondly that its weight remained the same. But in drawing this conclusion he makes assumptions. He believes that the salt appearing after distillation is the identical salt

which disappeared in the water. He could follow it for a time. He saw it change its condition from a lump to a powder. But when it went into the water it ceased to affect his sense of sight. Yet the fact that salt could be obtained from the water again leads him to think that it was in existence all the time. And he ascribes to the salt in its invisible state the change in weight of the water and the change in its taste. His belief in the continuity of existence of the salt, in its identity, rests on a postulate which for shortness we may term the continuity or identity postulate. Let us, for the sake of clearness, consider another example of the use of the same postulate.

Suppose that I am with a man whom I know, in a room with a door leading into another empty room, and suppose that shortly before my friend has gone into the other room out of my sight, and has now returned again. I do not suppose that he went out of existence in his absence; I believe that he was in the other room, preserving meanwhile his identity. I may have spoken to him while he was out of sight, and may have received an answer, and this affection of another sense than sight I ascribe to him. I base my belief in his continuity on the same postulate as that on which the experimenter bases his belief in the continuity of the salt. I have not a sufficient knowledge of philosophy to put the postulate in its proper form, but a consideration of cases in which it would not or might not apply may at least give us a working form of statement. If, during the weighing experiment, somebody had been observed introducing fresh salt on to the balance, we could no longer assert identity of the initial and final salt. Or if, in the second example, my friend had a twin brother in the neighbourhood, and if the adjoining room communicated with the street, I might not be sure of the identity of the friend underlying the two appearances. Perhaps, then, we may guard against such cases by the statement that "if a thing affects us in the same way as a thing has previously affected us, and if we have reason to suppose that no fresh thing has come in from the outside, then the two affections arise from the same thing."

Secondly, with our experimenter, we assume that the weights used in the counterpoise preserve a constant weight. Mr. Spencer seems to think that this assumption is ultimate or fundamental. But let us examine the assumption a little more closely. To begin with, we assume continuity of existence of weight. We have only direct sense-warrant for the existence of the down-pull while putting the weights on the pan with our hands and while

taking them off again. But we apply the continuity postulate and assert that the weight existed while the masses were on the pan. But we go further: we assert constancy in quantity, which is something more than mere continuity of existence, and we have various methods of testing our assertion. We may allow the weights to fall, and time their fall through a given distance in successive trials. All experience tends to show that the time of fall is constant, and we conclude that the weight is constant. It may be argued that we use a clock for the time, and that the clock pendulum may possibly vary in weight, simultaneously and in like proportion with the balance weights. Very well, then; let us use a watch, and we get still the same time of fall in our successive trials. Or let us use a different test, and put the weights on a Salter's Spring balance, and they always stretch the spring equally. If it be argued that possibly the elasticity of the watch spring and of the balance spring varies in like proportion with the weight of the weights, then, I say, let us go to the ultimate court of appeal—my own sensations. If I have practised much with my pressure sense and my muscular sense, I may weigh the weights with my hand and be certain of their approximate constancy. If it be finally argued that my sensations may likewise vary in proportion, then I say that so long as the universe is drawn to a consistent scale, and so long as I am also on that scale, any contraction or expansion of the scale, being beyond my detection, is a matter of perfect indifference to me, and I need not construct my language so as to provide for its possibility. I am content to say that the weight of the salt and the water is constant. But here I think that another postulate has crept in, which in its most general form we may state thus—"Like sensations imply like objective existences or like physical properties." We use the particular case that equal sensations imply equal objective existences or equal physical properties. For whatever test of constancy of weight we employ depends ultimately on the equality of two sensations. And indeed this postulate is the basis of all the conclusions as to the outside world which we draw from physical measurements.

Again, though we take weight as our test, the fact that the salt at the end resembles the salt with which we started in other respects than weight—in fact, that it gives us equal sensations—leads us to conclude that it is equal in quantity, *i.e.*, that none of it has been destroyed. And on such experiments so interpreted we found the principle of the Indestructibility of Matter.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from Vol. XI., page 294.)

3.—BLOCKING UP OF STREAMS.—Perhaps no one cause of floods has been more considered of late years than this, because it so readily suggests the remedy—cleaning out. The growth of weeds and accumulation of silt in the Nen, particularly since the diversion of traffic to the Northampton and Peterborough Railway, has greatly reduced the water-carrying power of its bed, and so, to some extent, been a cause of floods. The following remarks are intended to indicate, somewhat, the extent of responsibility this cause must bear.

The drainage area of the Nen above Peterborough is estimated at 620 square miles, and the ordinary summer flow of water through Peterborough Bridge at 5,000 cubic feet per minute, or 45,000,000 gallons per day. This is only about 70,000 gallons for each square mile of area drained, or ·005 inch of rain over the same area per day. The flood discharge through the same bridge has, however, amounted to 480,000 cubic feet per minute,* a quantity, it will be seen, ninety-six times the ordinary summer flow, and equal to about ·5 inch of rain over the drainage area in twenty-four hours. This is, no doubt, an exceptional amount, but in the Fen Districts of Lincolnshire and Cambridgeshire pumping power is usually provided for lifting half this amount, or ·25 inch of rain in twenty-four hours over the drainage area, into the main drains. A little consideration will show that, to prevent floods, a much greater provision would have to be made in the Nen Valley than in the Fens, for the "Upper Valley," that is the part above Peterborough particularly subject to floods, has an area of about 16,000 acres, which at times constitutes one vast reservoir, whilst the area draining into it is about 400,000 acres; so the Nen Valley has to receive the drainage of a district twenty-five times its size, whereas the Fen lands are only burdened with the drainage of a district about six times their own size.

Now, supposing the river were thoroughly dredged, and other improvements in the river bed effected, so as to reduce friction by one half, and double its capacity, these alone would not enable it to cope with the ordinary winter rains, which would deliver into the valley often from twenty to

* "Hydraulic Tables," by Nathaniel Beardmore, M.Inst.C.E.

fifty times as much water as is represented by its ordinary summer discharge, much less with some of the larger falls; for it is evident that so long as restricted channels exist, such as locks, sluices, waste-weirs, bridges, and narrow parts in the river itself, the discharging power of the river above them is only equal to their discharging power, whatever may be its capacity as a reservoir, and the locks and flood-gates at the various mills along the Nen would always be used in such a manner as to keep the river as nearly bank-full as now, until just before a flood was expected. For these reasons I have attached less value to the blocking-up of the Nen as a cause, and its cleaning out as a remedy for floods than many people, though it is a factor that should not be lost sight of, particularly in connection with certain other remedial causes.

Cleaning out and widening of a river anywhere does bring certain advantages, for it increases its storage capacity, and, therefore, the volume of water available for doing useful work in the dryer parts of the year, though alone it would not materially diminish floods.

The expense connected with a really efficient cleaning out of the river, and other works, would be very great at first, and for the cleaning out recurrent. The increased scour and consequent self-cleansing supposed, by some, as likely to result from a freer discharge of water, would not be perceptible eastward of Northampton because of the many impediments already referred to. The total fall of the Nen between Northampton and Peterborough is about 177 feet, but owing to the sinuous course of the stream, the average inclination is only 38·7 inches per mile; this, however, would allow of considerable scour but for the impediments. According to a survey made by Messrs. Siddons, in December, 1848, when from 10 to 30 inches of water was running over the sills of the different overshots, the total fall at the eleven staunches and thirty-three mills between Northampton and Peterborough amounted to 163½ feet, so that the actual inclination of the water between these various obstacles only amounted to 13½ feet, or an average of about three inches per mile, whilst at least 4in. per mile is needed to prevent silting up. As a matter of fact, when the overshots are not running, the motion of the water is only just perceptible, because held up in successive flats; and when they are running, owing to the perpendicular descent, the main body of water is not much accelerated. Under such a condition of things, weeds and other aquatic plants grow rapidly, and I anticipate it would be necessary to cut them twice a year to keep the stream in really good condition.

The real scour of flood water only occurs when the water is sufficiently high for the overshots, &c., to offer no serious impediment to its discharge, and then it scarcely affects the bed of the river, although it often does great damage to the banks and adjacent lands. The Nen from Northampton to Kislingbury, and from Northampton to Brampton, was cleaned out a few years since at a cost of about £1,500; also a small portion of the latter branch, near to the Castle Station, was straightened, being a necessary work in connection with the loop line of railway between Northampton and Rugby. These works have not prevented floods in the meadows west and north of the town, but none have occurred in the town itself since they were done. I doubt, however, whether any real trial of the improvements has occurred.

4.—ARTIFICIAL OBSTRUCTIONS.—Several of these have been briefly referred to already, but one or two require particular consideration.

Mills and their necessary weirs do tend to hold back water, and keep rivers nearly bank-full, with the result that floods are more easily induced. Complaints against millers and mills have been pretty continuous for a great number of years, and deservedly so perhaps, though mills need not be a cause of floods. The complaints are chiefly in respect to the excessive height of the floodgates and weirs, but sometimes on account of negligence in connection with the regulation of sluices and locks. There is always a tendency for mill-dams to get higher, for, supposing any impediment to the free flow of water to exist in the lower parts of the river, this will increase the height of the tail water at the mill next above. The result of this is that the miller here finds it necessary, in order to get the same power, to raise his head of water, but if he does not at the same time raise his wheel, he must raise the head more than the tail is raised, in order to overcome the resistance of the dead water; and so the banks are heightened, and possibly flash boards put up at the weirs, and it has happened that ancient weirs and back-brooks have been stopped. When this kind of thing is done at one mill, it must be repeated at the mill next above, and so the evil increases. A survey, made by Mr. Aris in 1826, showed that, owing to these operations, the water was raised between Thrapstone and Nun Mills, Northampton, twenty-three feet altogether above the legal height as ordered by the Commissioners of Sewers (9th Charles I., 1633).*

* See "Drainage of the Nene Valley," by the Rev. Charles Henry Hartshorne, 1848.

It has been suggested that if the whole of the water-mills on the Nen were pulled down, the sacrifice would be slight compared with the injury they inflict on the lands of the Nen Valley. This seems to assume that floods need not occur if mills were absent, an assumption not very justifiable, particularly if the river were maintained in a navigable condition. It seems to me that it would be a very retrograde step to do away with the mills, and cease to use the power of the river, particularly as the evils usually attributed to them can be remedied without such a drastic method.

Mills in some respects are an absolute advantage, for they help to keep back and conserve the water of rivers for the dry season of summer, which otherwise would be lost.

Bridges are answerable for part of the evil arising from floods. Some of the ancient bridges are inadequate to discharge the water wishing to pass through them, and the water may be at times a foot higher on one side than the other. This may be the result of faulty construction, or the blocking up of side arches through neglect. One of the most prominent instances of faulty construction was the old bridge at Wisbeach. This had a sectional area less than half that of Peterborough bridge, being only 796 square feet as compared with 1,856 square feet. The present bridge at Wisbeach has an area of 2,500 square feet.

A number of minor causes tend either to increase the amount of water reaching the valleys, or to bring it down more rapidly; such as *improved systems of village drainage*, and *diminution of woodlands;* also some of the improvements made by riparian proprietors to protect their own lands add to the flooding of others, both *by bringing the water more rapidly to the area below not improved*, and *by diminishing the flood capacity of the valley.*

The embanking of a river may even add to floods, for embanking the sides will usually lead to a raising of the bed, and so the water in all the streams feeding it will be kept higher, and the more easily be made to overflow. The same embanking, too, tends to prevent the discharge of floods into the river.

REMEDIES FOR FLOODS.—Several of the proposed remedies for floods have already been considered, because intimately associated with the causes, but one or two others remain to be considered.

Washes of the Nen.—Perhaps the most effective way of dealing with flood water, if the object is simply to diminish injury in a particular district, is that adopted in connection

with the Nen below Peterborough. For twelve miles below Peterborough a large basin or reservoir has been constructed, by making banks on each side of the river at an average distance of half a mile apart. This "*wash*," as it is called, has a superficial area of about 3,750 acres, or 1 per cent. of the area draining into it, and is sufficient to hold 1 inch depth of rainfall over the drainage area above it. An extraordinary flood fills this to a depth of 7 feet or more, but the water has never run over. The wash affords good pasturage in summer time. Like several of the other remedies referred to, this is only a partial one, however, for the heaping up of water in this wash both increases the velocity of discharge between it and the sea, and increases the height of the flood in higher parts of the valley. If this system of making flood-banks were carried out along the whole valley subject to floods, with a gradually decreasing sectional area, and the tributary streams were similarly treated to above the flood line, floods would be almost unknown outside this area, and only the superficial accumulation of water in a soil at present admitting of no effectual drainage would remain to be dealt with.

With regard to the other remedies, it is easy to see that if the *flood-gates* and *overshots* were made progressively larger towards the outfall, the latter being constructed so as to have a sectional area of discharge below the flood line equal to that of the total sectional area of the river above them, and also to give a less vertical fall to the water running over them, by continuing the inclined surface to about the low-water level of the river; if the river were progressively cleaned out in an opposite direction, and the locks and other artificial obstructions intelligently regulated, the narrow parts made wider, and the winding parts straightened, a very great improvement would be brought about; to the extent of preventing many floods, and facilitating the discharge of all. Such improvements carried out in the upper part of the stream only would, of course, add to the injury lower down, by bringing the water to these latter more quickly. The legal and pecuniary difficulties connected with the carrying out of these details would be very great, and the former, perhaps. under the present condition of legislation, insuperable.

It will have been noticed that the general tendency of nearly all the plans so far considered is to get rid of the water more rapidly than the present condition of things permits, so that a great scarcity of water would prevail during an ordinary summer. They all have the drawback that the water got rid of would do no useful work.

(To be continued.)

"THE NATURALIST IN NICARAGUA."*

Every naturalist, and especially every naturalist who is an evolutionist, will give a cordial welcome to this exceptionally interesting volume, which is "a narrative of a residence at the gold mines of Chontales; journeys in the Savannahs and forests; with observations on animals and plants in reference to the theory of evolution of living forms." Originally published by Mr. Murray in the year 1878, the popularity of the book soon exhausted the edition, and for many years it has become rare, and even disappeared from second-hand catalogues. If testimony other than that contained therein were wanting to its merits, the following eulogium, written by the illustrious Darwin in 1874, to his friend, Sir Joseph Hooker, is sufficient:—"Belt I have read, and I am delighted that you like it so much; it appears to me the best of all natural history journals which have ever been published." Mr. Belt dwelt in Nicaragua for four and a half years—from February, 1868, to September, 1872—and this is a record of what he saw, and of the theories which subsequently arose thereon:—"Some thought out on the plains of Southern Australia; some during many a solitary sleigh drive over frozen lakes in North America; some on the wide ocean; and some, again, in the bowels of the earth when seeking for her hidden riches. The thoughts are those of a lifetime, compressed into a little book."

The occupation of the author, who had been previously well schooled as a member of the Tyneside Naturalists' Field Club, and who had written many scientific papers in divers journals besides. was to superintend the mining operations of the Chontales gold-mining company. His scientific observations recorded in this volume were therefore—all honour to him—made in his hard-earned leisure. It is not stated whether he gained his fortune in his venture. Probably he did not. But he had another kind of wealth, surpassing the value of "gold and precious stones," which kings themselves cannot command. He had the seeing eye and the hearing ear to read the great Book of Nature, and the power to interpret the truths which Nature only reveals to her diligent and trustful students. Alas! it is truly said in the preface, that "his sun went down while it was yet day," for he died at Denver, Colorado, U.S.A., from the effects of mountain fever, at the early age of 45.

* "The Naturalist in Nicaragua," by Thomas Belt, F.G.S., second edition, revised and corrected, with map and illustrations. London: Edward Bumpus, 1888. Crown 8vo, pp. i-lxix., 1-403.

It is impossible within the brief limits of these pages to do justice to this beautiful volume, which abounds in observations and generalisations most valuable on inorganic (1), organic (2), and super-organic (3) phenomena. We can only touch on a few of the most interesting matters recorded in the order above indicated.

With regard to inorganic phenomena (1), we are, on the first page of the book, made acquainted with a typical instance of the rapidity which characterises some geological changes. The River San Juan receives the greater part of the drainage of Nicaragua and Costa Rica, and it is the outlet of the great lake Nicaragua into the Atlantic ocean. "Twenty years ago the main body of water ran past Greytown (San Juan del Norte); there was then a magnificent port, and large ships sailed up to the town, but for several years past the Colorado branch has been taking away more and more of its waters, and the port of Greytown has in consequence silted up. All ships now have to lie outside, and a shallow and, in heavy weather, a dangerous bar has to be crossed." Evidences of glacial action were traceable at San Rafael—boulder clay extended for miles, "and the angular and sub-angular stones that it contained were an irregular mixture of different varieties of trap, conglomerate, and schistose rocks;" but the author was "unprepared to believe that the glacial period could have left such a memorial of its existence within the tropics at no greater elevation above the sea than 3,000 feet." And again: "The evidences of glacial action between Depilto and Ocotal were, with one exception (that of striation, not always preserved), as clear as in any Welsh or Highland valley. There were the same rounded and smoothed rock surfaces, the same moraine-like accumulations of unstratified sand and gravel, the same transported boulders that could be traced to their parent rocks several miles distant." The author evidently believed in the existence of the fabled continent of Atlantis. Approaching the subject from the side of Natural History, he was driven to look for a refuge for the animals and plants of tropical America during the glacial period, when he found proofs that the land they now occupy was at that time either covered with ice, or too cold for genera that can now only live where frost is unknown. He had arrived at the conclusion that they must have inhabited lowlands now submerged, and, pursuing the subject still further, "he saw that all over the world curious questions concerning the distribution of races of mankind, of animals, and of plants, were rendered more easy of solution, on the theory that land was more continuous once than now;

that is, lands now separated were then joined together, and to adjacent continents; and that what are now banks and shoals beneath the sea, were then peopled lowlands." Volcanic energy and its effects are ably discussed in regard to Masaya, which, at the time of the Spanish conquest in 1522, was in full activity. "The credulous Spaniards believed the fiery molten mass at the bottom of the crater to be liquid gold, and through great danger, amongst the smoke and fumes, were lowered down it until, with an iron chain and bucket, they could reach the fiery mass, when the bucket was melted from the chain, and the intrepid explorers were drawn up half dead from amongst the fumes." The late Charles Kingsley's graphic description of the great eruption of St. Vincent, in 1812, is quoted from "At last;" and there is a very closely-reasoned passage showing that Mr. Belt had convinced himself that Lake Masaya and similar basins in the same area "have been blasted out," *i.e.*, formed by volcanic energy.

To the biologist, of course by far the most interesting portions of the book are those which deal with organic phenomena (2). The bright fiery-red colouring, on a black velvety ground, of the polygamous male tanager *(Ramphocælus passerinii)*, make it conspicuous to birds of prey, while the greenish-brown sober suit of the female is protective. Accordingly, "when a clear space in the brushwood is to be crossed, such as a road, two or three of the females will fly across first, before the male will venture to do so, and he is always more careful to get himself concealed amongst the foliage than his mates." Illustrations of mimicry abound. A curious longicorn beetle *(Desmiphora fasciculata)*, covered with long brown and black hairs, closely resembles the short, thick, hairy caterpillars that are common on the bushes. Insectivorous birds will not touch the latter, hence the beetle from its resemblance derives protection. Wasps and stinging ants have hosts of imitators amongst moths, beetles, and bugs. The author points out to those unacquainted with Mr. Bates's admirable remarks on mimetic forms, that "he has to speak of one species imitating another, as if it were a conscious act, only on account of the poverty of our language. No such idea is entertained, and it would have been well if some new term had been adopted to express what is meant." These deceptive resemblances are supposed by evolutionists "to have been brought about by varieties of one species resembling another having special means of protection, and preserved from their enemies in consequence of that unconscious imitation." Resemblances at first remote have in the course of ages become permanent.

The author's observations on ants are simply marvellous. Three forms were specially studied: the foraging ants (*Eciton hamata* and *E. predator*), the leaf-cutting ants (*Œcodoma* ——?), and a curious parasitic form peculiar to the "bull's horn thorn" (*Pseudomyrma bicolor*). Darwin has already shown, in the "Descent of Man," that the cerebral ganglia in ants are more developed than in any other insect. and in the Hymenoptera, of which they stand foremost, they are many times larger than in the less intelligent orders, such as beetles. Belt draws an interesting parallel between the Hymenoptera and the Mammalia, and points out that they both make their first appearance early in the Secondary geological period, but that it is not until the commencement of the Tertiary period that ants and monkeys appear. The parallel ends here, as no species of ant has attained great superiority over its fellows, while Man has advanced far above all other Primates. With this explanation, light is thrown on the proceedings of the ants. Respecting the foraging ants, it is mentioned as a curious analogy that, like the primitive races of mankind, they have to change their hunting grounds when one is exhausted and move on to another. In the capture of their prey they exhibited a well-planned system. Moving in dense masses three or four yards wide, and so numerous as to blacken the ground, "smaller columns would first flush the game—cockroaches, spiders, and other insects"—which, in the confusion, would sometimes bound into the middle of the mass, soon to be overpowered, bitten to pieces, limb from limb, and ultimately carried to the rear. Curious instances are recorded of the efforts of some of the victims to escape. In these the spiders exhibited the greatest intelligence, sometimes putting a good distance between them and their foes, at other times hanging suspended from a branch by a silken thread. Leaf insects feigned death sometimes. Ultimately the whole ground invaded, up even to the extremities of the twigs of the trees, would be cleared of every living insect, not too large to escape. The ant army is usually followed by a number of birds—ant-thrushes, trogons, creepers, and others—waiting on the trees, or pursuing and catching the insects that fly up. Among the ants, in addition to the dark-coloured workers and light-coloured officers, there are larger individuals "with enormous jaws." These are usually concealed. directing the others, and only appearing when danger arises. As to the leaf-cutting ants, their ceaseless pertinacity in the spoliation of the trees—more particularly of introduced species—their devastation of young plantations of orange, lemon, and mango trees, all this and more is told. The columns of these

ants are sometimes several hundred yards in length, reaching from the formicarium, or ant city, to the feeding ground. On closer examination a double stream of these minute pests, one laden with leaves, looking like a mimic "forest of Birnam," the other empty-handed and returning each for a leaf. The leaves are cut off with the sharp scissor-like jaws of the ant, clinging hold by one leg so that the leaf does not fall off. Mr. Belt actually satisfied himself that these leaves were carried to the formicarium, *not* to be eaten or used in forming the nest, but for the purpose of growing a minute fungus, upon which the ants feed—in fact, they are regular mushroom growers! The following, among many others, is adduced as an instance of the reasoning powers of these wonderful little animals:—"A nest was made near one of our tramways, and to get to the trees the ants had to cross the rails, over which the waggons were continually passing and re-passing. Every time they came along a number of ants were crushed to death. They persevered in crossing for several days, but at last set to work and tunnelled underneath each rail. One day when the waggons were not running, I stopped up the tunnels with stones; but although great numbers carrying leaves were thus cut off from the nest, they would not cross the rails, but set to work making fresh tunnels underneath them. Apparently an order had gone forth, or a general understanding been come to, that the rails were not to be crossed." The third form of ant studied by the author was that tenanting the interior of the "bull's horn thorn," a curious plant of the Acacia tribe, belonging to the *Gummiferæ*, with bi-pinnate leaves, growing to a height of 20 feet. It is a most remarkable case of commensalism. No harm is apparently done by the ants to the plant, for, notwithstanding that they feed on its honey-like juice, they in return protect it from the ravages of other insects (as these ants sting powerfully), especially those of their leaf-bearing congeners. The tricks recorded by the author of a tame white-faced cebus monkey were most curious and strangely human. It would tempt ducklings within reach by a piece of bread, and then kill them by a bite on the breast; it would pick pockets, pull out letters and take them out of the envelopes. "Once he abstracted a small bottle of turpentine from the pocket of our medical officer. He drew the cork, held it first to one nostril then to the other, made a wry face, re-corked it, and returned it to the doctor!" The humming birds noticed were both numerous and beautiful, and there is an instance recorded of their fertilising a rare pitcher plant (*Marcgravia nepenthoides*).

"The flowers of this lofty climber are disposed in a circle, hanging downwards like an inverted candelabrum . . . and the birds, to get at the pitchers (containing a sweetish liquid), must brush against them, and thus convey the pollen from one plant to another." The hairless dogs mentioned by Humboldt were seen by Mr. Belt, and it is pointed out by him that they would have an advantage in the "struggle for existence" over hairy ones, which are largely infested with Ectozoa in tropical climes. Among nocturnal animals "the skunks move slowly about, and their large white tails render them very conspicuous. Their formidable means of defence makes for them the obscure coloration of other dusk-roaming mammals unnecessary, as they do not need concealment."

Very little space remains to touch on super-organic phenomena (3). The country of Nicaragua, discovered by Gonzales, was subdued in 1522 by Hernando de Cordova; and in his book Mr. Belt over and over again speaks of the degenerate condition of the natives since the Spanish conquest, especially the half-breeds. He found everywhere proofs of the iniquity of the Spaniards and of the superiority of the old Indians—their ancient sculptures—their good government—their love of flowers. "No eye-servers were these Indians; before and behind they bestowed equal pains and labour on their work." As a redeeming feature, he speaks of the free hospitality of the present inhabitants. "It is the universal custom of the Mestizo peasantry to entertain travellers, to give them the best they have, and to charge for the bare value of the provisions and nothing for the lodging." Their absence of patriotism, and their indolence, is much to be deprecated. The only work is done by the females; the men keep up their dignity by lounging about all day, or lolling in a hammock, all wearied with their slothfulness, and looking discontented and unhappy. Law-suits are frequent, and the corruption of the judges, who are badly paid, is notorious. The absence of newspapers renders trustworthy intelligence impossible. Petty thefts are common enough, but robberies with violence are rarely committed. The remedy for all this is "the gradual moving down southward of the people of the United States. When the destiny of Mexico is fulfilled, with one stride the Anglo-American will bound to the Isthmus of Panama, and Central America will be filled with cattle estates, and with coffee, sugar, indigo, cotton, and cacao plantations. Railways will then keep up a healthful and continuous intercourse with the enterprising North, and the sluggard and the sensual will not be able to stand before the competition of the vigorous and virtuous." Several pages

towards the end of the volume are devoted to the history of that very remarkable custom, called the "Couvade," still surviving in Nicaragua, in which the father is put to bed on the birth of a child, and receives the congratulations of his friends, while the mother goes to work as usual!

We close this deeply interesting book with reluctance. It is a worthy companion of such classical works on the doctrine of evolution as Bates's "Naturalist on the Amazons," Wallace's "Malay Archipelago," and Ernst Haeckel's "Visit to Ceylon." They make a noble quartet.

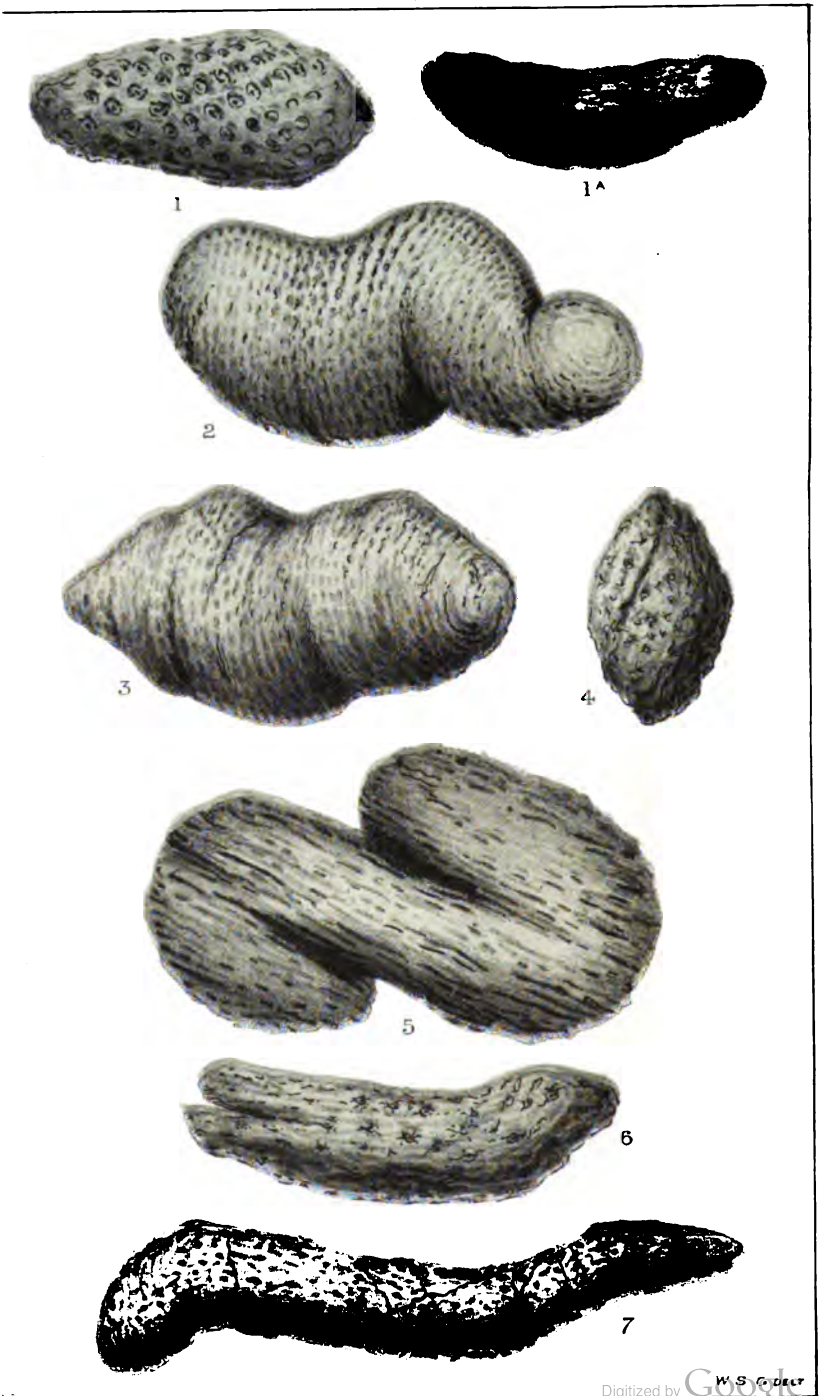
W. R. H.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, December 4th. Mr. W. B. GROVE in the chair. Mr. Benjamin Ward was duly elected a member of the Society. Mr. Herbert Stone exhibited a collection of skins from Toowoomba and Warwick, Queensland, including wallaby, koala or native bear, opossum, native cat, kangaroo, ornithorhynchus, and tail of the dingo. Mr. T. E. Bolton, a living specimen of *Clathrulina elegans*, rare. Mr. W. H. Wilkinson, stellate hairs on deutzia leaves, showing different forms of mounting, and illumination under the microscope. Mr. W. B. Grove, B.A., three specimens of *Geaster fimbriatus*, from Boldmere, near Sutton, where they were found in a garden. This is the first time that this beautiful and rare fungus has been found so near Birmingham. It has been previously found at Allesley and Alcester, and at Blockley. Also (for Miss Gingell) *Ag. carcharias*, *Paxillus revolutus*, a newly described and figured species; and (for Mr. Pumphrey) *Ag. pyrotrichus* and *Ag. cyathiformis*, from Gloucestershire.—BIOLOGICAL SECTION, December 11th. Mr. R. W. CHASE in the chair. Mr. J. E. Bagnall, A.L.S., exhibited a series of plants from near Great Yarmouth, collected by Mr. R. W. Chase, including *Orchis incarnata* and *Stellaria palustris*; also, from Dursley, collected by Miss Gingell, a number of rare mosses, such as *Barbula tortuosa*, *Hypnum stellatum*, and *Gymnostomum microstomum*, giving their distribution throughout the world. Mr. E. H. Wagstaff, an example of *Polycistina*, in dry state, from Barbadoes. Mr. W. B. Grove, B.A., announced the recent discovery at Sutton of one of the earth stars, *Geaster fimbriatus*, the first time any of these interesting fungi have been recorded from North Warwickshire since the days of Withering and Bree. Mr. W. B. Grove then gave his paper on "The Salmon Fungus (*Saprolegnia*) and its Allies," giving a very full and interesting account of the mode of growth, reproduction, and effects of these parasites. They are great enemies not only to salmon, but also to fish and other animals preserved in aquaria, which are frequently infested with them when alive. It is stated that carbonate of soda prevents their growth. A discussion followed, in which Messrs. R. W. Chase, J. Levick, W. R. Hughes, and J. E. Bagnall took part.—GEOLOGICAL SECTION, December 18th. Mr. F. W. Carpenter was elected a

member of the Society; Mr. T. H. Wa 3.A., B.Sc., and Mr. John Udall, F.G.S., were unanimously elec chairman and secretary respectively of the section. Mr. Pu hrey exhibited (1) potato stones from Madagascar and from Somersetshire; (2) ironstone nodule from Kingswood Pit. This contained a number of cylindrical bodies apparently intersecting each other. Mr. Grove, on behalf of Mr. Clarke, showed two old-fashioned plates of great beauty: (1) of fungi; (2) of mosses. Mr. T. H. Waller read a very interesting and instructive paper on a "Lithia-bearing Granite," illustrated by experiment and micro-sections. Mr. C. J. Watson presented twelve micro-slides of sections of plants, &c., which he had mounted.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 12th. Mr. J. Madison showed specimens of *Limnæa truncatula* var. *minor*, from King's Heath. Mr. P. T. Deakin then read a paper on "The Flying Power of Birds." The writer described the bony parts necessary for flight, their position, use, and peculiarities, and the various developments and modifications in the different families of birds. The varying depth of the keel of the sternum and other modifications in the woodpeckers, diving birds, waders, and others was described. The paper was illustrated by a series of dissections of birds, comprising specimens of most of the principal families of the British species.—November 19th. Mr. Deakin exhibited specimens of *Neritina fluviatilis* var. *cerina*, from Christchurch; Mr. J. Madison, distorted specimens of *Dreissena polymorpha*; Mr. Corbet, various specimens of hematite, from Newhaven.—November 26th. Mr. Deakin exhibited specimens of *Helix fusca*, from Clent. The evening was chiefly taken up by a discussion on the sealing, ringing, and finishing of microscopic slides, specimens being shown by Messrs. J. W. Neville, Collins, and Moore. The difficulty of securely sealing glycerine mounts was spoken of by most members, Mr. H. Hawkes recommending Damar varnish as preferable to all others.—December 3rd. Mr. J. W. Neville showed the tracheal system of *Pediculus capitis*; Mr. J. Collins, pollinia of *Orchis morio*; Mr. J. Moore, variations in the structure of hair from different breeds of dogs; Mr. Camm, *Cephalosporium acremonium*, from Hamstead, and *Craterium pedunculatum*, from Sutton Park.—December 10th. Mr. J. Collins exhibited a section of *Ripogonium parviflorum*, a New Zealand cone; Mr. J. Moore, specimens of *Vespa sylvestris*, and *Volucella plumata*; Mr. J. Madison, specimens of *Succinea putris* and *Helix rotundata*, from the Eocene beds of Headon Hill; Mr. Camm, the following fungi:—*Arcyria incarnata* and *Lamproderma irideum*. Mr. J. A. Grew then read a paper on "Insect Mimicry." The writer said the most wonderful instances of mimicry were found in exotic insects. Those resembling leaves and sticks were familiar to all. But in our own country we had many remarkable instances, though the insects were smaller and less known. The writer described mimicry as a tendency on the part of insects to imitate other objects. If we observed them closely, we should find many insects, including the guileless butterfly committing shams and frauds. In doing these, colour was a great factor. A number of instances were given where the insects and larvæ resembled the objects they rested on or associated themselves with. The writer said he should leave to a future occasion the purpose of such habits and coloration. The paper was illustrated by a collection of the insects referred to.



Herald Press Lith Birm.

STIGMARIÆ.

NOTE ON FURTHER DISCOVERIES OF *STIGMARIA* (? *FICOIDES*) AND THEIR BEARING UPON THE QUESTION OF THE FORMATION OF COAL-BEDS.

BY W. S. GRESLEY, F.G.S., M.E.

(*a*) In the first place it will be well to point out very briefly the present state, as far as I know it, of the controversy regarding this fossil plant, namely:—Was it always part of a plant—a root of a tree; or, was it only sometimes a root, and also sometimes an individual plant? That it was never a plant *sui generis* is the opinion very decidedly held by our greatest authority on the subject, namely, Professor Williamson, F.R.S. Mr. Carruthers, F.R.S., also rejects the opinion that an individual plant is sometimes represented in this fossil. From the writings of Sir W. Dawson, F.R.S., I gather that he believes only in the tree-root idea.

On the other hand, we have Prof. Leo Lesquereux, in America, whose opinion, after forty years of exploration of the coal measures for fossils, is that Stigmaria has not the structure of a root, and lived more as a creeping stem—an individual plant—than as a root of a tree. In France, M. H. Fayol and other *savants*, uphold much the same opinions as Lesquereux.

Basing my own conclusions upon certain fossils which I am about to describe, and from other considerations, I am compelled to hold much the same opinions as those held in America, France, &c.

(*b*) The true or complete character of Stigmaria then, being, in my opinion, still open to question, perhaps some additional light may be thrown upon the matter by making

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REFERENCES TO PLATE II.

FIGURE 1, 1A.—Sketches of specimen of a Stigmaria in the British Museum (Natural History Department), South Kensington. No. 10,430, in Case No. 31, in Palæontological Plant Collection. About $\frac{1}{3}$ natural size.

FIGURE 2.—Stigmaria from out of the "Eureka" Coal-seam, Newhall Park Colliery, Leicestershire Coal-field. $\frac{1}{3}$ natural size.

FIGURE 3.—Stigmaria out of the "Little Flint" Coal-seam, Madeley, Salop. (Coalbrookdale Coal-field.) $\frac{1}{3}$ natural size.

FIGURE 4.—End view of Stigmaria from out of the "Top Hard" Coal-seam. Glapwell Colliery, Derbyshire. $\frac{1}{3}$ natural size.

FIGURE 5.—Side view of Stigmaria from out of the "Little Flint" Coal, Coalbrookdale Coal-field. $\frac{1}{3}$ natural size.

FIGURE 6.—Stigmaria do. do. $\frac{1}{3}$ natural size.

FIGURE 7.—Stigmaria (in 11 fragments) from the "Top Hard" Coal-seam, Glapwell Colliery, Derbyshire. $\frac{1}{6}$ natural size.

known the following facts, which have recently presented themselves to the writer. Since the appearance of my communication to the Geological Society of London last June, entitled "Notes on the Formation of Coal-Seams, as suggested by evidence collected chiefly in the Leicestershire and South Derbyshire Coalfields," my particular attention has again and again been drawn to the important fact of the underclays of coal-seams whose only fossil contents are those of Stigmaria; clays, often of great thickness, with this fossil occurring at all horizons in them, but with no remains of Sigillaria Lepidodendron, &c. (the aërial portions of trees); also, the fact of like beds of Stigmaria clay being unassociated with a layer of coal or of coally material. Such fossils seem to show clearly, or at any rate are highly suggestive of these beds not representing old soils at all, and that they (the Stigmariæ in them) were seldom the roots of trees. If they were, how happens it that we very rarely indeed come across any connections between roots and stumps, as is much more frequently the case in other strata, viz., the arenaceous roofs of coal-seams, in sandstones, &c.?

My former paper also contained what practically amounted to a challenge to those who assert that coal-beds are the fossil remains of *forests*, which grew (in their earlier stages at all events) with their *tree-roots* in the underclays, to produce evidence that the Stigmariæ in the underclays were originally connected with the coal as *tree-roots*. Now, it seems to me that the fact of only two anything approaching *bonâ fide* examples of this phenomenon having been communicated to me since I wrote* as having been observed, but which, when I came to enquire closely into, turned out to be fossil tree stumps, which might or might not have had the roots attached *in situ*, as they were never actually seen but only supposed to be there, supplies me with additional good cause for so soon again bringing this subject to the fore.

(*c*) It may be well if I relate the order in which my discoveries have been made, namely, how I have been led up to writing these remarks. In my former paper I gave it as my opinion that fossils resembling Stigmaria (organisms with rootlets attached *in situ*) were occasionally found having all the appearance of being individual plants *sui generis*. High authorities, however, rejected my idea. I examined the

* My paper had a wide circulation amongst coal-mining men, being published in two mining journals at home, in two in America, and in other ways; so that there has been plenty of time for anyone to make known their discoveries if any have been made.

Stigmarian Collection in the British Museum, which, I may perhaps be allowed to remark in parenthesis, requires considerable additions to make it what it should be, as worthily representing some of the peculiar characteristics of this fossil, which, in a national collection, one expects to see. Here, in Case No. 31, in the room devoted to fossil plants, is exhibited a specimen of Stigmaria (specimen No. 10,430), and labelled as follows: "Stigmaria ficoides. Brog: Coal-measures, Coalbrookdale, Salop, a '*Terminal.*'"* This singular specimen is roughly the size and shape of a large flattish potato, measuring about 5in. × 2in. × 1½in., and is composed of clay-ironstone. (Plate II., figs. 1, 1A.) Upon its flattest upper surface, as exhibited, are fairly-well preserved and numerous regularly distributed rootlet-scars where the rootlets had their attachment. These markings are of large size, say ⅛ of an inch in diameter, but they gradually die out round the sides and ends of the specimen, and do not seem to show themselves at all upon the underside. Now, as this fossil is admitted (presumably by the authorities of the Museum) to be a "terminal," and by "terminal" is understood to represent the outward end of a root or branch, but as both ends of the specimen are practically alike, I suppose it is left to the beholder to call just whichever end he pleases the "terminal." If one is a terminal the other must be, and so both ends being terminals the object must, I take it, be regarded as an *individual plant*, and not as merely a *fragment of a root*. This specimen having come from Coalbrookdale, I repaired thither in search of other like or unlike fossils. My journey was not taken in vain, for I consider I had the good fortune to very soon come upon fossils presenting in many respects similar facies to the one in London; fossils, if not distinct from tree-root remains, can scarcely be shown to have once occupied such positions.

In the lowest workable coal-seam in the neighbourhood of Madeley and Hawley, about four miles to the east of Wellington, Salop, occur innumerable specimens of Stigmaria (? ficoides), not merely impressions of the exterior of the plant, as so very frequently observed by the writer upon the laminæ of coal, including cannel and anthracite, but as casts of what have the appearance of being individual plants chiefly composed of sandstone, but now and then of clay-ironstone or largely of pyrites mixed with siliceous material. From personal observation as well as from minute enquiries

* Dr. Hy. Woodward, F.R.S., tells me this fossil is not so labelled. —W. S. G.

made on the spot of those who are daily in a position to notice these fossils (I refer to the underground managers and officials at the collieries in the district), it seems that these fossils always lie horizontally, or in the plane of the seam, and have never been seen to cut obliquely across the grain of the coal. In shape and bulk they vary between about 4 inches and 2 feet (seldom less or more) in length, and in diameter or thickness from 2 to 7 inches; they are generally flattish. In form or shape they vary greatly, some being nearly straight, others bending in angles up to 80° or 90°, or possessing a twisted, crumpled, distorted, and even folded appearance. (Plate II., fig. 5.) Branched or forked specimens are not unfrequently found. (Plate II., fig. 6). Many of the smallest examples are of about the same bulk as a penny bun (Plate II., fig. 4), being nearly circular and from 1 to 2 inches thick. More rarely they assume a kind of double hooked or S shaped form, the twists being vertically nearly under one another, or the upper bend may be a foot or so (Plate II., fig. 5) distant from the lower bend ∽, such bends being turned a good deal to one side (horizontally). The various forms noticed are by no means easy to describe; they could be much more easily understood by the aid of short rolls of some plastic material such as clay or dough, which could be quickly worked up into the forms of these fossils were it necessary. Now, as regards the terminals of these fossil forms, all I can say is, that with many of them the ends are well and neatly rounded off, exhibiting more or less clearly the characteristic stigmarian markings (the rootlet-scars). With others, and probably with the majority of specimens, the case is somewhat different; their ends are either tapered down to nothing hardly, or the sandstone assumes an uneven or serrated surface, being interstratified with the coal, so that we lose the original form of the fossil, either from its being impossible to separate the coal from the stone, or because the fossil has been forced out of shape. Specimens possessing well-defined terminals, therefore, are difficult to extricate from the coal. As is usual with almost every specimen of Stigmaria we meet with, these Salopian examples show the rootlet-scars more clearly upon one side than upon the other, and in common with most others, possess little, if any, remains of internal organisation. They merely possess the external markings already alluded to. and sometimes indications of the central axis (medullary cavity or a vascular cylinder). Their position in the coal seam varies, being in one place most numerous in the upper portion, in another in the middle, and now and then chiefly in the lower portion, whilst in some

localities they appear to occupy positions in all layers of the seam as well as to extend to the roof.

In some places these things are so numerous as to make the coal unworkable.

The name of the coal-seam is the "Little Flint," and below is a section showing its thickness, &c.

	FT.	INS.
Sandstone giving place to Shale towards north and east. - - - - - -	varies.	
Little Flint coal-seam with many Stigmaria, about - - - - - - - -	2	9
Hard grey Sandstone, without fossils, about	4	0
Coal, called "Lancashire Ladies" - -	a few ins.	
Blue Shale - - - - - - - -	varies.	

That the Stigmariæ in this (Little Flint) coal-seam are remarkable would seem clear from the fact that, so long since as 1833, Prof. Prestwich called attention to them in his memoir on the Coalbrookdale Coalfield (see "Trans. Geol. Soc.," second series, Vol. V., page 441). It would appear that he then regarded these fossils as plants distinct from trees, as he used the term "stems" when describing them.

From what I could learn in the district, such a thing as any approach to fossils showing the connection of Stigmaria with a tree stump, has never yet been met with in this coal, notwithstanding hundreds of fossils are turned over with and separated from it every day. Surely this fact is of great importance!

In the Leicestershire coal-field is a seam called the "Eureka" coal, which, by the way, occupies very nearly, if not, the same horizon in the measures as the Little Flint does in those of Coalbrookdale, Now, in this coal-bed are found Stigmaria fossils in almost the same way as at Coalbrookdale (Plate II., fig. 3), being identical in shapes and in bulk, but not often met with excepting close to the top of the coal. They are invariably, I am informed, completely imbedded in the seam. and have not been observed turning upwards into the roof and assuming the form of the stool of a tree—forms commonly known in the mines as "pot-bottoms" or "pot-holes." All these Leicestershire (Eureka coal) specimens, like their neighbours in Salop, are sandstone casts, and exhibit next to nothing in the way of internal structure.

I have also come upon similar short lengths of Stigmaria with rounded terminals, some of which resemble, in some degree, those of the South Kensington Coalbrookdale individual, in the Derbyshire coal-field at Glapwell Colliery, where, as the manager and the men tell me, they always "run

out to nothing at both ends."* (Plate II.. figs. 4 and 7.) Again, it should be remarked that a flattish circular clay-ironstone specimen, about 4ins. across, was found by myself, in August last, on a pit-bank near Mangotsfield, in the Bristol coal-field.

All this points to the conclusion that these particular forms of Stigmaria are exceedingly common, at any rate in certain areas. Believing, as I firmly do, that almost every Stigmaria specimen we find has lived and died on the spot, though some may have been transported along with the vegetable matter in which they had root to greater or less distances; and that as they occur in sandstone, in coal, in cannel, and black carbonaceous mud (shale), and in clay (underclay), it seems perfectly clear that the plant, whether the tree-root or other type, did not find the material of which underclays were or are composed *essential to its growth.* An ample supply of moisture would appear to have been the one thing needful for its support.

(d) On the strength, then, of the British Museum "terminal" specimen, and on the individual plant-like Stigmariæ of the Little Flint coal of Salop, the Eureka of Leicestershire, and of others found in Gloucestershire and Derbyshire, and also of what Lesquereux and the French school firmly believe to be the true reading of the fossil, I beg leave, in conclusion, to put the following questions, which, I maintain, must be fully and satisfactorily answered before it can be *positively asserted that in Stigmaria we have a root only.*

1.—Does the organic structure of Stigmaria, so far as made out, preclude the possibility of its being an individual plant; in other words, are we compelled, on botanical grounds, to give an unqualified rejection to a belief in a plant *sui generis?*

2.—As the material of these Salopian and other fossils in coal is usually sandstone, it will probably be argued by many that they are remnants of tree roots, which, during the existence of the stump became filled up with sand even to their very extremities. Are we not equally justified in assigning another cause or explanation of the phenomenon—namely, that these things have become sandstone much in the same way as the large nodular masses of pyrite often found in coal, or as those Stigmariæ which are composed of clay-

* These occur just at the top of the "Top-hard" coal-seam (5ft. 6ins. thick), and what is remarkable about them is that I am told they always lie with their longer axis more or less N. and S. or parallel with the "cleat" or master-joints of the coal, "end on" as the mining term is.—W. S. G.

ironstone, or occasionally wholly of pyrite, have been formed? In short, are they not just as likely to be of concretionary origin (replacement of organic vegetable matter by iron), as they are to be due to infilling from the roof of the seams? *

3.—With regard to the shape of the fossils: Do not their rounded-off terminals (resembling in many cases that of a cucumber), as well as the peculiar serpentine or folded aspect of many of them, demand some other explanation of their form than that which supposes them one and all to be the result of chemical alteration combined with pressure brought on during solidification of vegetable matter into coal? (Plate II., figs. 2 and 5.)

4.—Had these Stigmariæ been tree roots, how is it that all traces of the stems or stools have disappeared? Why were none of them preserved as sandstone casts if that were the case with the roots?

5.—Another botanical point: Is it not just as logical to say:—As Stigmaria was the root of at least two different trees (Sigillaria and Lepidodendron), and that as Lepidodendron branches sometimes terminated in Halonia, what is there to prevent us from allowing that Stigmaria may *sometimes* have existed without any upright or aërial stem at all?

6.—In regard to beds of coal: Inasmuch as it does not appear that the roots of Sigillaria, &c., have been shown to be Stigmaria from the study of specimens found in underclays; how can it be said that the Stigmaria-looking fossils in these clays had a similar organisation to the tree-root Stigmaria, or that they were ever *really roots at all*?

7.—In what other way are we to account for the fact of the Little Flint coal in Coalbrookdale resting, not upon an underclay, but directly upon a bed of sandstone in which it is stated there are no Stigmariæ at all, except we conclude that the coal did not commence to grow as a forest of trees, &c., or that it was an aqueous formation? †

* It has always appeared a difficulty with me in accepting the idea held by many of us, that when we find Stigmariæ as tree-roots many yards in length, and in the shape of complete *casts* of the roots, composed entirely of Sandstone, the sand must of necessity have come in through the stump of the tree and found its way along the roots to their terminals, filling up the roots gradually *towards the stump*. That a decayed tree root, whether it grew in what is now coal or in sand, could be so filled, seems to my mind, an impossibility. I look upon these fossils as having been formed by infiltration of siliceous matter through their outer bark or coatings—a gradual replacement of wood tissue by mineral matters.

† Not necessarily transported by water, but certainly not grown on dry land.

8.—Seeing, then, that as Stigmaria does not occur below coal-beds in the shape of roots, and that we have strong grounds for supposing that it was not always a root, am I not perfectly justified in saying that, in my opinion, the fossils from Shropshire and other localities furnish forms the true character of which is impossible to be misunderstood? At all events I say this, that in absence of proof to the contrary, the Stigmaria question is not yet settled. If the specimens here brought under our notice are not considered good enough to set the matter at rest, it is hoped that better ones will soon be forthcoming.

9.—Do we not seem to have very good ground for concluding that *Stigmariæ* (? the tree-root types) were aquatic or water-loving plants, since they so frequently occur—evidently *in situ*—in cannel, a substance, I suppose, we all firmly believe to have been formed or grown in water (or at all events a kind of black vegetable slime or soft mud)? For instance, at Glapwell, in Derbyshire, no less than an area of 300 acres of cannel, varying in thickness between 2½ and 12 inches, has been proved to exist in the middle of the "Top Hard" coal —a seam averaging 5ft. 6in. thick. Stigmaria is common in this cannel.

10.—As Prof. Williamson says in his memoir on *Stigmaria ficoides*, "no plant should be regarded as Stigmaria unless its internal organisation is typically identical with that of *S. ficoides*;" it follows, does it not, that as the particular specimens I am describing in this paper have parted with their internal structure, and only possess the usual outward markings or *stigma* (rootlet scars), we have no proof that they were ever roots of trees at all? We are hardly justified even in concluding that they ever belonged to *S. ficoides*. It is surely by *inference* only that the two things can possibly be said to be one and the same fossil under different conditions!

11.—I should be the last to quarrel with those who assert that the tree-root type (Williamson's *S. ficoides*) may sometimes have become broken up under pressure or consolidation into short lengths, resembling, more or less, some of the forms I have here figured, but when we come across specimens so very numerous and so little resembling the *form even* of tree roots or fragments thereof, I do think we are dealing with a species differing from *S. ficoides* (Williamson).

THE FOUNDATIONS OF OUR BELIEF IN THE INDESTRUCTIBILITY OF MATTER AND THE CONSERVATION OF ENERGY.

A CRITICISM OF SPENCER'S "FIRST PRINCIPLES," PART II., CHAPTERS IV., V., AND VI.

BY J. H. POYNTING, D.SC., F.R.S.

(Concluded from page 11.)

Passing on from this, let us consider another experiment: that of the swinging pendulum described by Mr. Spencer. And to begin with, let us suppose that I set it swinging with a blow. It starts off in rapid motion, but as it rises up the motion gets less and less and ultimately ceases; only however for a moment. Back it comes on the return journey, and, when once more at the starting point, it is moving as nearly as I can judge at the original rate. Again it rises up, now on the other side. and with speed slackening till it stops; again it returns and so on, the oscillation continuing though the motion is intermittent. As Spencer points out, the motion of the pendulum is the objective correlate of our sense of muscular effort experienced in starting it, not, however, mere effort like the effort of holding a weight in a given position, but of muscular effort combined with motion, for we pushed the hand along in giving the pendulum the blow. It is unfortunate that we have no single sensation which we naturally correlate with the combination of effort and motion, but we all have the idea fixed firmly enough in our minds as work, and this is shown by the common use of the term. To take a familiar example. If bricks have to be carried up a scaffold, the work done is naturally measured by the weight of bricks multiplied by the height of the scaffold; or we think of this product, force × distance, as describable by the single term Work. Hence we say the motion of the pendulum is the objective correlate of the work done by us. Now as the motion disappears, does it go out of existence? and as it begins again, does it start afresh? Our continuity or identity postulate is ready at our elbows to suggest identity of the motion in succeeding oscillations, and we have a confirmation of the suggestion that it still exists, even when it disappears as motion, in the fact that if at the top of the swing we lay hold of the pendulum it pulls at our hands; it is ready in fact to give back to us work such as we gave to it. We conclude then that there is a continuity of existence, at one time showing itself as motion, and at another

manifested only in the pull exerted by the pendulum on the hand. That to which we assign continuity we term energy—kinetic when it shows itself as motion, potential when it is only inferred to exist from the position of the body and the knowledge of the work it will do. We may use as a symbol, to enable us to think of this potential energy, the energy of a stretched indiarubber cord. If a boy projects a ball attached to such a cord, the ball gradually loses its motion but the cord stretches, and in this state of stretch we suppose it to possess the energy previously in the ball. If we think of some invisible connecting machinery between the earth and the pendulum, we may conceive this machinery as stretched when the pendulum rests at its highest point, and as in that state possessing the energy lost as energy of motion by the pendulum.

So far I have closely followed Spencer's masterly analysis of this example, here and there replacing his terms by those more commonly used by physicists, but in his succeeding statements I can no longer go with him. Let us examine one or two of these statements. He argues that the sense of muscular effort is the subjective symbol both for force and for energy, though he recognises that in the latter case the feeling of effort is joined with consciousness of motion. It is true that when we exert mere muscular effort without moving our limbs, we do work and so lose energy and even become tired, but that is due to the particular mechanism employed. If we study the separate muscular fibres instead of the whole limb, we find that they are moving even when we are exerting only a dead pull or push without motion. And so our sense of effort probably accompanies a supply of energy to the muscles, and our feeling of fatigue probably accompanies a loss or absense of energy. The combination of effort with motion uses up a great deal more energy and leads more rapidly to fatigue, but the fatigue is of the same kind in both cases. In the objective world, however, force and energy are entirely distinct. We speak of the steam pressure in the boiler without confusing it with the horse power of the engine, one being force per square inch, the other energy per minute. We speak of the weight of a consignment of goods, and we admit the justice of the mileage rate of charge for its carriage by rail, one being force, and the other a charge proportional to energy expended in the carriage.

The physicists, through painful experience, aware of the extreme importance of keeping these two ideas of force and energy distinct, or rather of recognising that the one contains something over and above that which the other does, are

repelled by Mr. Spencer's attempt to reduce both to force. They recognise that our muscular sense is misleading inasmuch as it gives us a consciousness of loss of energy when we exert force alone, and only a consciousness of greater loss joined with an inadequate consciousness of motion when we do external work. They say that if effort be correlated with force it is a mistake to correlate it also with energy, and that if we do naturally so correlate it the correlation can only lead us astray.

Another statement which it is difficult to accept, is to the effect that the existence which we have termed energy, must show itself either as motion or as strain—*i.e.*, either as kinetic energy or potential energy. A system in which after any interval the kinetic energy comes back when the bodies are again in their original position is termed a conservative system, and it is of such a system alone that it is strictly accurate to say that the sum of the potential and kinetic energies remains the same. When and only when we have such a system are the forces persistent, *i.e.*, dependent only on the distances of the bodies apart. It is *supposed* (not, as Spencer says, *assumed*) that astronomy furnishes us with a grand example of a conservative system, inasmuch as our proofs of the indestructibility of matter lead us to suppose that the planets have constant masses, and our measures of their distances and motions show that when the distances repeat themselves the velocities recur. The masses being constant the energy must have all returned. But even in this case it is suspected that the forces are not quite persistent, though we have no certain proof of the fact.*

Terrestrial motions are all affected by friction, a sworn enemy to conservation, since by opposing the motions it always ends them without putting any potential energy in their place. Careful examination of cases of friction shows, however, that there is still a sign of the continuity of existence of that which for a time appeared as kinetic energy, and then on vanishing, led us to believe that it still existed as potential or strain energy. This new sign is heat—something affecting a new sense. Further study shows other signs—as light affecting the sense of sight—and chemical energy, sometimes perhaps affecting the sense of taste. Then in some cases the phenomena of magnetism and electricity are developed, phenomena which lead us to believe that there is latent energy

* I may here point out an error into which Spencer appears to have fallen, confounding the equality of action and reaction with persistence of force. One is a relation true at any instant, the other a relation true in successive instants.

ready to turn into heat, or kinetic or chemical energy in the electric circuit, latent since we have no electric or magnetic senses to detect it.

All these results lead us to believe in the truth of the principle of the continuity or identity of energy, a principle evidently founded on the identity postulate, since what we observe is that energy passes from one form and that simultaneously energy appears in another form, and that when it passes from this latter form we can obtain energy again in the original form. But this continuity does not necessarily imply constancy in quantity. That is another principle founded on experiment. Determinations like those of Joule tend to show that when energy changes from one form to another there is a fixed rate of exchange. If then, using the known rates of exchange, we suppose all energy converted into one form, experiment leads us to suppose that the sum total is constant.

We can now see in what sense it is true that energy must show itself either as kinetic or as strain. It is only true if we assume that light, heat, and the rest are either kinetic or strain energies or mixtures of the two.

This brings me to the consideration of another part of the work of the physicist.

His main work, as I have said, is the determination of resemblances or similarities, and he groups phenomena according to these. In the course of scientific work many of these groups are shown to resemble each other—one set of phenomena is shown to be a mere combination of phenomena already known, and the phenomena are then said to be explained. Thus Wells showed that in the deposition of dew there is a cooling of the earth's surface, cooling therefore of the moisture-laden atmosphere in contact with it, and deposition of some of the moisture. In other words, he showed that the deposition of dew resembled other depositions of water, and so he explained it. Or again, Faraday explained the formation of electricity by the jet of steam in the hydro-electric machine when he showed that there was friction between the drops of water carried by the steam jet, and the sides of the orifice past which they rushed, that the two were oppositely electrified, and that it was therefore similar to other known cases of electrification by friction. And numberless other instances might be given.

But the physicist is not content with explanations which he can prove. He is an inveterate builder up of hypotheses for the most part unverifiable, but that hardly troubles him. His hypotheses are always attempts to imagine such a

condition of affairs that he may continue the work of explanation, *i.e.*, of detection of hidden similarities. For instance, a solid body is, to our senses, a continuous something entirely filling up a space. If it is heated it expands; if it is soluble in water, it disappears when put in water. If we make no hypotheses, we can go no further. The expansion of a continuous solid is unlike anything else, and is therefore inexplicable; but I hold—and here I think Mr. Spencer would consider me quite hopeless—that there is no difficulty whatever in conceiving of the expansion of continuous matter. Again, the disappearance of the continuous salt in continuous water is inexplicable, but I have no sense warrant that it is not going on, and I may be driven to attempt to conceive it. But now let me introduce the unverifiable, or, at least, unverified, hypothesis that matter is discontinuous, and really consists of separated particles, and I can explain expansion:—it resembles the scattering of a crowd. I can explain solution:—it resembles the mixing of two crowds, and so on.

Again, we have recognised various forms of energy—kinetic, affecting the sight in one way, or light affecting it in another way, or heat affecting the temperature sense, but we cannot say that any one of these resembles any other. Without hypothesis they are inexplicable. But, let me suppose that the ultimate particles of matter possess both strain and kinetic energy, and that, when they bump against my skin, they affect my temperature sense, and I explain heat. I show that a hot body resembles known mechanical systems. Or, let me suppose that even where I cannot see or feel matter there is still something which can be acted on by the ultimate particles of matter and receive energy from them, and I can explain light as being waves sent out in this intangible something by the vibrating atoms. I show that it resembles other cases of waves sent out from vibrating sources in water or in air.

No doubt this longing for explanation which possesses us is in part strengthened by our belief in identity. If energy is continuous in its existence, then we suppose that in itself it must be the same in kind, though now it affects one sense, now another, and now none at all. We go on from this another step and suppose that if we could only train our senses sufficiently we should be able to follow the energy through all its transmigrations, and see it ever the same in kind. The senses used in the investigation of visible motion, the muscular sense, the touch, the eye, are the most thoroughly trained, and work best together. We, therefore, naturally fix on these as the senses which are, in imagination, to follow the energy up, and so our hypotheses are constructed

to enable us to explain all phenomena as cases of mechanical action and mechanical motion—to explain all the forms of energy as kinetic and potential.

As yet, our hypotheses are unverified, and, for the most part, they appear likely to remain so, for it is difficult to conceive of any test of their truth. And until they are verified we must ever bear in mind that new hypotheses may at any time be devised, which may explain phenomena even better than the old ones. So, it behoves us to be cautious in committing ourselves to doctrines as to the indestructibility of matter or the continuity of motion, which are based on hypotheses as to the structure of matter and the nature of energy. We need have no fear that without these doctrines science would be impossible. If matter is destructible and motion ceases, there is only the more work for the physicist to do in determining the conditions of annihilation. He can still find resemblances, can still explain the complex unknown as made up of the simpler known. And when his senses fail to guide him, he can still invent hypotheses whereby his imagination may come to their aid. His science will only stop when he comes to the ultimate ideas, the inexplicables, in terms of which all phenomena are to be described—inexplicables, in that they can be no further resolved, in that they are utterly unlike each other but not unknowable, for we know them one from the other, and we know them as the threads with which is woven all that we have yet discovered of the pattern of the universe.

But this is not an exposition of Mr. Spencer's chapters. I seem to have travelled so far on a diverging path, that I have almost lost sight of the goal to which he would lead. Let me attempt, in conclusion, to state in a few words where I think we diverged.

While Mr. Spencer holds that common experience of matter and motion, if rightly interpreted, leads to the belief in the indestructibility of the one and the continuity of the other, I hold that common experience only raises a presumption, the belief is only rightly and firmly founded on the results of careful and exact quantitative experiments. While he holds that they are necessary truths, I still think it conceivable that they are false. While he regards them both as leading to the persistence of force as the ultimate postulate, I very much doubt whether any relation between definite ideas is a postulate. The postulates which I have used are both of them conditional propositions. If so and so, then so and so. In fact, I suspect that the mind is provided only with machinery ready to arrange the results put into it by the senses, and that it does not contain any results ready made.

NOTES ON A TOUR IN NORWAY AND COLLECTION OF PLANTS.

BY W. P. MARSHALL AND C. PUMPHREY.

(Concluded from page 6.)

In Hooker's standard account of the Arctic Flora (Transactions, Linnean Society, Vol. XXIII., p. 251), the North of Norway and Lapland, a district of which the North Cape is the the central point, is described as containing by far the richest Arctic flora, amounting to three-fourths of the whole; moreover, upwards of three-fifths of the species and almost all the genera of Arctic Asia and America are likewise Lapponian, or belonging to this Lapp district.

The striking fact was brought out by Hooker that this Lapponian Flora is the most widely distributed flora over the earth; it not only girdles the earth in the Arctic Circle, but dominates over every other flora in the North Temperate Zone of the Old World, and intrudes conspicuously into every other temperate flora, and has even migrated into southern latitudes. The greatest number of Arctic plants are located in Central Europe, no fewer than 580 out of 762 inhabiting the Alps and Central and Southern Europe.

Hooker considers this fact can only be accounted for by Darwin's hypothesis that the existing Lapponian Flora is of great antiquity; that during the advent of the glacial period it was driven southward, and even across the tropics into the Southern Temperate Zone; and that on the succeeding warmth of the present epoch, those species that survived ascended the mountains of the warmer zones, and also returned northward, accompanied by aborigines of the countries they had invaded during their southern migration; their present distribution being accounted for by continuous slow changes of climate during and since the glacial period.

The following is a list of the plants collected in this Norway Tour:—

NORWAY PLANTS COLLECTED JULY-AUGUST, 1888.

Ranunculus acris	M.
„ aconitifolius	V.F.
Trollius europæus	N.C.
Aconitum septentrionale	R.
Arabis thaliana	E.
„ hirsuta	N.C.
„ alpina	E., N.C.
Cardamine amara	Tm.
„ pratensis	U.
Sisymbrium sophia	Vk.
Draba incana	Vk., L.
Cochlearia officinalis	N.C.
Braya alpina	L.
Capsella bursa-pastoris	L.
Viola Riviniana	R.
„ tricolor	Tm.
Drosera rotundifolia	Vk.
„ anglica	So.

Polygala vulgaris	E.
Dianthus deltoides (?)	R.
Silene rupestris	J., L., R.
,, acaulis	N.C.
Lychnis dioica	Tm.
,, flos-cuculi	E.
Sagina nodosa	L.
,, nivalis	Vk.
Stellaria graminea	E.
Cerastium alpinum	N.C., R., Nb.
Spergula arvensis	Vk., L.
Hypericum perforatum	Vs.
Geranium pratense	Tm.
Lotus corniculatus	Tm.
Anthyllis vulneraria	Tm.
Vicia cracca	R.
Lathyrus pratensis	Sv.
Spiræa ulmaria	M.
Alchemilla vulgaris	B.
,, alpina	R.
Potentilla rupestris	Tm.
,, tormentilla	Tm.
,, anserina	Vk.
Comarum palustre	M.
Rubus chamæmorus	Vk., Tt.
,, arcticus	Tm.
,, saxatilis	Tm.
Dryas octopetala	N.C.
Geum urbanum	M.
,, rivale	Tm.
Pyrus padus	Tm.
Epilobium alpinum	Vk.
,, montanum	Tm.
,, angustifolium	Vk.
Circæa alpina	E.
Sedum annuum	Vk., R.
,, Rhodiola	N.C.
,, sexangulare	Sv.
Saxifraga oppositifolia	N.C.
,, aizoides	Nb.
,, cotyledon	R.
,, cæspitosa	N.C.
,, stellaris	V.F.
Parnassia palustris	L.
Carum carui	Tm.
Cornus suecica	Sv., L., Tm.
Viburnum opulus	Tm.
Linnæa borealis	M.
Galium saxatile	Tm.
,, verum	L.
,, boreale	J., Nb.
Aster tripolium	M.
Erigeron acris	R.
,, alpinus	R.
Solidago virga-aurea	Vk.
Gnaphalium supinum	J.
,, sylvaticum	E.
Antennaria dioica (male)	Tm.
,, ,, (female)	E.
Arnica montana	Vk.
Pyrethrum inodorum	Vk.
Cotula coronopifolia	L.
Chrysanthemum leucanthemum	Tm.
Centaurea jacea	J.
Apargia ——	Tm.
Mulgedium alpinum (Sonchus)	V.F.
Crepis virens	Vk.
—— tectorum	Vk.
Lobelia Dortmanni	Vd.
Campanula rotundifolia	U.
Andromeda polifolia	M.
Erica tetralix	M.
Menziesia cærulea	Nb.
Loiseleuria procumbens	N.C.
Vaccinium uliginosum	Tm.
,, Vitis-idæa	Sv.
Pyrola secunda	L.
,, rotundifolia	Sv.
,, uniflora	Nb.
Gentiana campestris	L.
Mertensia maritima	Sv.
Myosotis arvensis	R.
Verbascum pulverulentum	L.
Linaria vulgaris	L.
Scrophularia nodosa	Vk.
Pedicularis sylvatica	Vk.
Euphrasia officinalis	Vk.
Veronica chamædrys	Tm.
,, beccabunga	Tm.
,, officinalis	Tm.
,, saxatilis	Vk.
Galeopsis versicolor	Vk.
Pinguicula vulgaris	Vk.
Trientalis europæa	Tt.
Statice armeria	Sv.
,, danica	N.C.
Rumex acetosella	Nb.
Oxyria reniformis	Nb.
Polygonum viviparum	Sv.
Empetrum nigrum	U.
Salix retusa	Nb.
Orchis conopsea	E.
,, mascula	J.
,, maculata	Vk.
Gymnadenia conopsea var. densifolia	R.
Habenaria bifolia	Sv.
Maianthemum bifolium (Smilacina)	M.
Tofieldia palustris	Sv.
Narthecium ossifragum	Vk.
Juncus acutifolius	M.

Eriophorum alpinum	Nb.	Lycopodium annotinum		
„ polystachyon	J.	„ clavatum		
Carex echinata	M.	Polytrichum commune		M.
„ umbrosa (præcox)	E.	Sphærophoron coralloides		L.
„ atrata	N.C.	Lecanora ventosa		L.
Phleum pratense	Sv.	Cladina rangiferina (Reindeer Moss)		L.
„ alpinum	Nb.	Cladonia furcata (Reindeer Moss)		L.
Poa Schlerochloa	L.	„ gracilis		L.
„ alpina	R.	„ cornucopioides		L.
Festuca ovina	Tm.	„ uncialis var. humilior		L.
„ rubra	M.	„ digitata		
Equisetum sylvaticum	Tm.	Lecidea contigua var. meiospora		
„ palustre	N.C.	Parmelia physodes		
Polypodium calcareum	R.	„ saxatilis		
„ vulgare, var. acutifolium	Vk.	Ricasolia amplissima		
Woodsia ilvensis	R.	Cetraria Islandica var. crispa (Iceland Moss)		
Polystichum lonchitis	R.			
Asplenium trichomanes	E.			
„ septentrionale	R.			
Lycopodium selago				

REFERENCES TO THE LOCALITIES WHERE THE ABOVE SPECIMENS WERE TAKEN :—

B.	Bergen.	U.	Utvik.
M.	Molde.	Vd.	Vadheim.
Tm.	Throndhjem.	L.	Laerdalsoren.
Tt.	Torghatten.	J.	Jostedal.
Sv.	Svartisen.	Nb.	Nigaards Brae.
N.C.	North Cape.	Vk.	Vik.
R.	Romsdal.	V.F.	Voring Fos.
Vs.	Vestnaes.	E.	Eide.
So.	Soeholt.		

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Concluded from page 16.)

ADDITIONAL REMEDY.

The additional remedy I have to propose has been already very explicitly described in previous pages, and so the details need not be given here. Briefly it consists in giving facilities for flood-water to get into the river gravel, which almost everywhere underlies the present river bed and stretches to a good distance on each side of it, and in providing *dumb-wells* or *swallow-holes* for this river gravel to drain into a good water-bearing bed below. from which Northampton and other towns and villages might be supplied with water. It does not aim so much at preventing floods as providing water;

nevertheless, it would prevent the smaller floods, and mitigate the larger. allowing them to do the maximum amount of good, and less harm than they do now. Below is a summary of the advantages likely to result from the application of this method:—

1:—The river gravel of the Nen, with its cap of alluvium, naturally represents the former extent of the river when in flood, and now approximately coincides, in superficial extent and position, with the area subject to floods. The average depth of the gravel is almost certainly greater than the average depth of flood-water, therefore, if the flood-water at any time present on the ground had free access to it, and found it empty. such water would be wholly or nearly disposed of, and the whole flood greatly reduced in intensity. The dumb-wells, constructed for other purposes, would tend to keep the river gravel empty, and access to the gravel would be greatly facilitated by the various devices already proposed, and so a great quantity of water completely prevented from doing harm, particularly if the river were connected with the gravel. Not only would the river gravel act as a reservoir, but it would be continually emptying and making room for more water, to the extent the dumb-wells are able to receive such water.

There need be no fear of the gravel being over-taxed as a filter, for within the area dealt with, there would be almost as many square miles of filtering material as acres would be required for the assumed maximum capacity of the dumb-wells, at the rate of 1½ square yards for each 1,000 gallons in twenty-four hours, or a descent of about 6 inch per hour.

2.—The water disposed of would not be lost to the district, and if used as this scheme suggests, it would be returned to the river in a pretty regular volume, after having served some useful purpose. I find that the utilisation of the river gravel as a temporary reservoir for flood-water was suggested some years ago by Professor Prestwich.* The suggestion arose out of a proposal to construct impounding reservoirs along the Thames Valley for the same purpose. Professor Prestwich's remarks were about as follows:—The Thames and Cherwell were liable to floods of such magnitude that, however useful storage reservoirs might be in providing additional water in times of drought, no practicable extent of storage could prevent floods. Large reservoirs, in fact, already existed, compared with which any artificial reservoirs

* "Rainfall and Evaporation," by Symons, Greaves, and Evans. Discussion on the Papers. Proceedings of the Institute of Civil Engineers, 1876.

which could be constructed would be insignificant. In the neighbourhood of Oxford the valley spread out to one to one-and-a-half miles for a distance of four or five miles, giving an area of some 3,000 acres. Both lower down and higher up the valley a succession of similar basins existed, in all of which the alluvial clay was underlaid by a bed of gravel, varying from five feet to twenty feet in thickness, and the water in this was held up by impervious beds below. Some drainage works at Oxford, in which the main drains were laid at a depth of about sixteen feet for a distance of two miles, permitted a study of the conditions here. It was noticed that at the bottom of the gravel there was always sufficient water to supply the wells to a village of 700 inhabitants, standing in the middle of the valley, and to supply the adjoining reservoir for the water-works of Oxford; also, that as rain continued, the water gradually rose in this gravel up to and above the alluvial clay, and then floods ensued. It was thought probable that these natural reservoirs might be utilised for the storage of winter rain by damming back at the narrowest parts the water held in the gravels of the larger basins, and so arranging that the water could be discharged at lower levels down the river in periods of drought.

3.—It would render possible the drainage of districts in which it is now practically impossible, because (except by the expensive expedient of carrying the drains to lower parts of the river) there is nowhere to drain into, the meadows being really below the level of the water in the river when the latter is moderately full. If drainage is necessary for uplands, how much more so is it for lowlands? And if it brings all the advantages attributed to it, the benefits to be derived from this scheme must be very great.

4.—The lowlands would still have the advantages of flood water in the shape of manure and fine silt from the uplands, which now renders ordinary manuring unnecessary. Also the meadows would be well irrigated without the serious disadvantages arising from stagnant water. There are some places along the Nen Valley where a comparison between the moving and stagnant water of floods may be made. On the south side of the valley, near to Great Houghton, for instance, the river gravel is not overlaid by alluvium, and the land is about a foot higher than on the north side of the valley; the consequence is the water runs away into the gravel very rapidly, and every flood seems to enrich these meadows, whereas on the opposite side of the river, in the parish of Abington, exactly the contrary effect is produced.*

* "Drainage of the Nene Valley," by Rev. Chas. Hartshorne. Report of John Beasley, Esq.

5.—*The land would be rendered much more valuable for grazing purposes*, for the herbage would be improved; the period during which it could be stocked lengthened by perhaps two or three months; and diseases of cattle, and rot in sheep in particular, would be much less likely to occur. It is not uncommon, under the present condition of things, for fields to be covered with water continuously for 12 or 18 weeks in the year.

6.—*The climate would be locally improved.* At some periods of the year, when there is little wind, it is very noticeable how a bright warm morning brings a dull or even wet afternoon and evening, followed again by a clear night. This is very harassing to farmers, and from observation of such occurrences I have been led to infer that in these circumstances the clouds are locally formed, by the rapid evaporation from large surfaces of flood water, or wet lands. With dryer lands and less surface water this would be less likely to occur. It is a fairly common belief that the moon has some particular power to disperse clouds, because a fine night will often follow a dull day; there is very little doubt that just the opposite is the case, the night is fine because of the impotency of the moon to cause evaporation and produce clouds.

The effect on the health of human beings and cattle would be decidedly beneficial. A malarious atmosphere is created not by water, but by the action of the sun on decaying vegetable matter, and such there will very frequently be where land cannot be drained. Ague, once so common in the Fen districts, has now nearly disappeared through drainage; only droughts in autumn now are likely to occasion it.

CONCLUSION.

The water scheme that has been described in these pages embraces a small district only, and proposes to deal with a comparatively small quantity of water, but the principle admits of very general application, and there are signs that it is receiving attention from water engineers.

Water is not manufactured in the ground, neither is there an inexhaustible supply there, but it all gets in from the surface somewhere; it follows, therefore, that the continuance of underground sources is a matter of rainfall and percolation.

The rainfall of this country varies from something like 165 inches in the Lake district to 20 inches in the East Midlands, and the average for the whole country is rather over than under 30 inches, an amount quite sufficient for all purposes of human consumption, manufactures, and maintenance of rivers and canals; yet water is scarce, and all

modern improvements in country and town tend to make it more so, both because more water is used, and special facilities are given for the water not immediately required to find its way into the main streams, sometimes polluting them, and sometimes causing them to overflow.

Of course the rapid removal of all stagnant surface water is highly desirable, and in a country like England, the atmosphere of which usually has plenty of moisture in it, a diminution of evaporation from any cause is distinctly beneficial, but the rainfall need not necessarily be such an enemy as most modern drainage schemes seem to imply.

Floods always have been, and probably always will recur at times. The truth of the first of these propositions is evident from the great lateral extension of the river gravel, or alluvium, or both in most river valleys; and of the second from the inability to provide means whereby the drainage of a large area may be made to pass sufficiently fast into the porous beds underlying a much more limited one, when the rainfall is heavy; or be discharged sufficiently fast by the ordinary bed of the stream.

Rainfall does serve many useful purposes; it washes the atmosphere, feeds rivers and lakes, sinks into the ground and forms springs, flushes drains, and generally cleanses towns, but when it gets into situations where it can and does do damage, it is too often permitted to do it without exacting any equivalent of useful work from it. This arises partly from two sets of persons not acting together; some people want water, others want to get rid of it, by mutual agreement they might both be more completely satisfied.

Mr. De Rance estimates that there is an area of 26,688 square miles of superficial permeable rock in this country, and 19,808 square miles of impermeable with permeable underneath, and he has suggested that the latter area should be fed by means of *dumb-wells*, both to prevent devastating floods and yield water.

I would suggest that where permeable beds can be supplied in the manner I have proposed, that is by the intermediation of any superficial beds of gravel or sand—the river gravel or drift for instance—that would be the better plan. The supply of deep-seated water, from a given drainage area, would be much greater than if the outcrop of the water-bearing bed had been enlarged to an equal extent, and left as we now usually find it, covered with soil, and perhaps with provision for surface or under-draining. Further, innumerable small sources of water might be made available, and preserved as it can never be in open reservoirs, and this at less cost than by any other system.

The loss from floods all over the country has been greater of recent years than before, because of the higher cultivation of the land. This consideration alone suggests increased necessity for dealing with the question, and although some lands do not readily admit of the chief remedy proposed in these pages, it has been at least shown that some do, and these latter would not only be subject to less injury, but be better than they have ever been, hence the principle ought to receive as much support from owners and occupiers of land subject to floods as from the corporations of towns needing water.

A NEW BOOK ON LEAF-FUNGI.*

BY W. B. GROVE, B.A.

For a long time the British workers on "Leaf-Fungi" have laboured under the greatest difficulties. With the exception of those who had access to Winter's "Kryptogamen-Flora," and a few isolated magazine articles, they have been left entirely in the dark about the great advances in knowledge obtained in recent years by those who have worked at the biology of this group. Bare descriptions of species are not knowledge, although they are the first and necessary preliminary thereto. But now, thanks to Mr. Plowright's monograph, for the first time those mycologists who are confined to English books may enter upon the work of the year, with regard to Leaf-fungi, fully equipped for understanding the characters and the relations of the species they meet with.

These relations are now shown to be far less simple than had ever previously been suspected. The triumphant establishment of *heterœcism*, in which (*pace* Mr. Massee) I still think Mr. Plowright has taken no mean share, has not only demonstrated that those leaders of mycologic opinion in this country who so long and so obstinately pooh-poohed it, were incapable of appreciating the evidence, but has also made it clear that the intermingling and intercrossing of species and host-plants is so complex that nothing but persistent artificial cultures can ever disentangle them.

As an example we may take the species of Puccinia which grow upon *Phragmites communis*. These were formerly

* A Monograph of the British Uredineæ and Ustilagineæ, with an account of their Biology, &c., by Charles B. Plowright. London: Kegan Paul, Trench, and Co., 1889, pp. 348, and eight plates; price 10/6.

confused together; there are now known to be three:—*Puccinia phragmitis* (=*P. arundinacea*), the æcidia of which grow upon *Rumex conglomeratus*, *obtusifolius*, *crispus*, *Hydrolapathum*, *Rheum officinale*; *P. trailii*, the æcidium of which is confined to *Rumex acetosa*; and *P. magnusiana*, which has its æcidia on *Ranunculus repens* and *bulbosus*. But this is not all. An æcidium also occurs on *R. bulbosus* which is scarcely distinguishable, morphologically, from the one just mentioned, but which belongs to a Uromyces having its teleutospores on *Dactylis glomerata*, and another Uromyces, having its teleutospores on species of Poa, has its æcidia on *R. bulbosus* and *repens*, as well as on *R. Ficaria*. Still further to complicate matters, another Uromyces occurs upon *R. Ficaria*, which has been proved to have no connection with the æcidium upon the same plant. Once more, there is still another Uromyces which grows upon all the species of Rumex mentioned above (including *R. acetosa*), but which has no connection at all with any of the other parasites. Finally, the æcidium on *Ranunculus acris*, which used to be undistinguished from those on the other *Ranunculi*, is found to belong to a species (*Pucc. perplexans*), which it was reserved for Mr. Plowright to discover.

It must be remembered that all these statements have been proved by experimental cultures, in which not only the positive results must be regarded, but also the negative results obtained in the various methods of "control" cultures. The latter, indeed, are far more convincing than the former. If, on sowing the spores of an æcidium on another plant, we obtain a Puccinia, the result may be put down to chance, and was explained in this way by the older school. But if, in a series of similar experiments, we find that the Puccinia invariably appears where we have sowed the æcidium, and invariably does not appear (if proper precautions be taken) where the spores of the æcidium have not been applied, the conclusion that the one is produced from the other becomes very probable. If again, on sowing the promycelial spores obtained from the Puccinia on a suitable host, we invariably get the æcidium with which we started, and don't get it (under similar conditions) when the Puccinia has not been applied, the demonstration is complete. When these results are confirmed by hundreds of experiments made by observers of different nationalities, it is mere fatuity to doubt any longer.

I have been led into this digression because undoubtedly the chief value of Mr. Plowright's book lies in its biological aspect. but it is also an enormous advance upon all previous English works in its morphological descriptions, which may be

regarded as "Winter"—improved. There are a number of good woodcuts, and eight excellent plates, lithographed by Messrs. West, Newman, and Co., most of which are made from the author's original drawings. The typographical arrangement is especially neat and convenient. The book is well indexed—that of "host-plants" being particularly useful—and will be simply indispensable to all students of Leaf-fungi in this country.

Wayside Note.

FRESH WATER LIFE.—While examining some specimens of *Carchesium polypinum* and *Vorticella nebulifera*, I noticed a peculiar feature in them I had never seen before, although I have had them under the microscope on and off for years. I allude to a number of thin, long, transparent filaments clothing the pedicels of these creatures, notably the *Carchesium*. Some were quite thick with these aforesaid filaments. Whether anyone else has noticed them I do not know; but certainly I have seen no notice or sketch of them in any of our manuals. I have thought them worth just a passing notice. I may add that I have only at present seen the filaments on specimens from one place. They much reminded me of the transparent thin filamentous rootlets so commonly seen in *Nitella flexilis* and others of the Characeæ.—E. H. W., Edgbaston.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION. The 100th meeting of this section was held on November 27th, Mr. W. R. Hughes, F.L.S., in the chair; nineteen members present. Mr. Bagnall exhibited for Mr. Hughes thirty-one species of plants from Cobham Lane, Kent. For Miss Gingell, *Echium vulgare*, *Viola Reichenbachiana*, and *Polygala vulgaris* from Dursley. For himself, *Ulex Gallii* and *Ag. cyathiformis* from Corley Rock. Mr. Hughes exhibited a leaf of a Virginian creeper from the back of Dickens's house; also a new photograph of Mr. Herbert Spencer. Mr. Stone exhibited the skull of a marmoset, an echinus, *Phyllacanthus imperialis*, a large beetle, *Hylotrupes dichotomus*, from Japan, and pseudomorphs of *Ammonites tuberculatus* and *A. lautus* in iron pyrites, from Lyme Regis. Mr. W. P. Marshall, M.I.C.E., read his paper on "Modern Railways," illustrated by a number of maps and diagrams.—SUPPLEMENTARY MEETING, December 6th, 1888, Mr. W. R. Hughes, F.L.S., in the chair; eight members present. It was proposed by Mr. A. Browett, seconded by Mr. Stone and carried, that the dates of the supplementary meetings be altered from the 1st and 3rd Thursdays in the month to the 2nd and 4th. Mr. Stone exhibited the wing of the eucalyptus leaf insect which simulated the leaf of the eucalyptus so perfectly as to deceive even an experienced eye; the midrib and minor veins being accurately reproduced. Miss Goyne read the latter portion of the eighth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Transformation and Equivalence of Forces."

THIRTIETH ANNUAL REPORT

OF THE

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY,

PRESENTED BY THE COUNCIL TO THE ANNUAL MEETING, FEBRUARY 5TH, 1889.

The Council is pleased to be able to report that the Society has fully maintained its position during the past year 1888; the standard of the papers read and the attendance at the meetings having been well kept up. It is encouraging to notice that this year again confirms the expectation that the loss of members owing to the raising of the subscription has now practically ceased.

A Conversazione was held on October 30th, similar to the one at the opening of the Session in the previous year, and it proved very satisfactory, and was carried out at very small expense. It was held in the Examination Hall, Mason College, and amongst the exhibits were a fine case of Pallas's Sand Grouse, prepared by Mr. Chase; an interesting series of glass photographs, and a collection of objects under microscopes.

An Excursion to Dovedale was taken on Whit Monday; the party driving from Derby through Ashbourne to Dovedale, where they were kindly received by the Rev. W. H. Purchas, Vicar of Alstonefield, who conducted the party about the Dale.

The eleventh Annual Meeting and Conversazione of the Midland Union of Natural History Societies was held at Northampton on July 4th and 5th; Mr. W. R. Hughes and Mr. W. H. Wilkinson attended as the delegates from this Society. The meeting was held in the Town Hall, the chair being taken by the Right Hon. Earl Spencer, K.G., and an address was given by the Rev. H. H. Slater, F.G.S. The Darwin gold medal was awarded to Mr. J. E. Bagnall, A.L.S., for his "Flora of Warwickshire." On the following day excursions were made to Fawsley Park and other places of interest in the district.

The treasurer's annual financial statement shows the receipts of the Society for the past year to have been £153 1s. 6d., and the payments £152 9s. 5d., including the repayment of one of the six £10 loans, and leaving a balance due to the treasurer of £1 5s. 5d., instead of £1 17s. 6d. at the end of the previous year. The receipts for the year have more than covered the expenditure for the year, leaving a surplus to pay off the above loan; and the Council now

appeal earnestly to the members for their assistance in paying off more of the loans during the present year, by increasing the income of the Society through obtaining additional members. By an alteration recently made in the Laws, ladies can now become members of the Society on the same terms and with the same privileges as family members, by the payment of half-a-guinea per year; and it is hoped that this will lead to an increase in the number of lady members.

The total number of members for the year 1888 is 201, being 7 less than in the previous year (8 ordinary members and 4 corresponding members); of the total, 7 are life members, 145 ordinary (guinea) members, 12 family (half-guinea) members, 5 lady (half-guinea) members, 5 honorary vice-presidents, 28 corresponding members, and 4 associates.

On the occasion of the retirement of Mr. Charles Pumphrey from the office of treasurer of the Society an illuminated address was presented to him, which was kindly prepared by the president, Mr. W. B. Grove.

The Council have to report that the negotiations which were begun upon the proposed amalgamation of this Society with the Birmingham Philosophical Society have been suspended.

MICROSCOPICAL SECTION (*Ex-officio:* President, W. B. Grove, M.A.; Secretary, W. H. Wilkinson).—During the year eight meetings of the section have been held, with an average attendance of fifteen; and the following communications have been made:—

March 6th.—"The Present and Future of Science Teaching in England, with special reference to Botany," by PROF. W. HILLHOUSE, M.A., F.L.S., being the retiring president's address.

May 1st.—"An Account of the Foraminifera dredged by the Society during the Oban Excursion in 1883," by MR. E. W. BURGESS, communicated by MR. W. P. MARSHALL, M.I.C.E. A fine slide of 67 specimens (illustrative of the paper), named and mounted by MR. BURGESS, was presented to the Society.

May 29th.—"On Kew Gardens and some of the Botanical Statistics of the British Possessions," by MR. J. G. BAKER, F.R.S., F.L.S., communicated by MR. J. E. BAGNALL, A.L.S.

June 6th.—"Notes on some Foraminifera collected and mounted by MR. E. W. BURGESS from material obtained near Oban by the Society during their dredging excursion in 1883." By MR. J. F. GOODE; illustrated by specimens in microscopes, and by a fine series of micro-photographs in the oxy-hydrogen lantern, by MR. J. EDMONDS.

The meetings of May 1st and October 2nd were devoted to Microscopical Soirées, and both were very successful. A large number of microscopes was exhibited by members representing all the sections of the Society.

At other meetings, Mr. W. R. Hughes exhibited a collection of flowers from the White Mountains, U.S.A.; Mr. W. B. Grove exhibited a number of fungi, both of the larger and smaller and minute kinds, some beautifully shown under the microscope, and amongst the many rare ones several were new to Great Britain; Mr. J. E. Bagnall exhibited many rare plants, both local and from a distance; Messrs. W. P. Marshall and C. Pumphrey, a collection of plants and mosses, which they brought from their tour in Norway; Mr. W. H. Wilkinson exhibited some very high Alpine plants from Scotland, a collection of lichens from Mount Stewart on the Island of Bute, also the lichens from the Northampton Excursion, and some very beautiful foreign species; Mr. R. W. Chase exhibited some birds, and gave an account of an ornithological excursion to the East Coast; Mr. Herbert Stone exhibited a collection of animal skins from Queensland; Prof. Harrison presented to the Society a fine sample of the polycystina earth from Barbados, which the members are now working out; Mr. C. Pumphrey exhibited photographs of flowers, &c., by the oxy-hydrogen lantern.

BIOLOGICAL SECTION (President, R. W. Chase; Secretary, J. E. Bagnall, A.L.S.).—During the past year the section has held eleven meetings, and owing to the industry and zeal of its members these meetings have been fully sustained in interesting and instructive matter. On eight of the evenings papers have been read, and on every evening there has been a good display of specimens, and the discussion arising thereupon has often been of great interest. The principal exhibitors who are members of the Society were Messrs. W. B. Grove, R. W. Chase, W. R. Hughes, W. H. Wilkinson, J. B. Stone, Herbert Stone, C. Pumphrey, C. Wainwright, J. Edmonds, W. P. Marshall, E. H. Wagstaff, and J. E. Bagnall. In addition to these we have been greatly indebted to the following non-members of the Society: Miss J. R. Gingell, Rev. T. Norris, Rev. D. C. O. Adams, and Father H. P. Reader. To Miss Gingell the section has been especially indebted for the trouble and expense she has been at in forwarding week by week abundant specimens of flowering plants, mosses, and fungi, from the district around Dursley, Gloucestershire. The attendance during the present year has been well sustained, the average being seventeen. The following is the list of papers:—

February 14th.—On "The Successful Use of Oil to Calm Rough Seas," by MR. W. P. MARSHALL, M.I.C.E.

March 18th.—"New or Noteworthy Fungi," Part IV., by MR. W. B. GROVE, M.A.

April 10th.—"Notes upon Birds which have become extinct, and those species which are likely to become so in Great Britain," by MR. R. W. CHASE.
May 8th.—"Notes on the Flora of Settle" (Illustrated), by Rev. W. HUNT PAINTER.
June 12th.—"Notes on some Plants of the Rhine Land," by MR. W. B. GROVE, M.A.
October 9th.—"Notes on Norway Plants recently collected by Messrs. W. P. Marshall and C. Pumphrey," Illustrated.
November 13th.—"Notes on the Corvidæ (Jackdaw, Raven, &c.)" (Illustrated), by MR. R. W. CHASE.
December 11th.—"The Salmon Fungus, 'Saprolegnia,'" (Illustrated), by MR. W. B. GROVE, M.A.

GEOLOGICAL SECTION (President, T. H. Waller, B.A., B.Sc.; Secretary, John Udall, F.G.S.).—Eleven meetings of this section have been held during the year, and have been well attended, giving an average attendance of twenty-one per meeting. The section is specially indebted to Mr. Waller for several valuable papers; to Professor Lapworth for a special paper on "The Red Rocks of the Birmingham District," and for his kindness in conducting an excursion of the section from Halesowen Station to the Clent Hills; and to Mr. C. Pumphrey for his assistance on several occasions in illustrating papers with his oxy-hydrogen lantern.

An interesting feature of the year's work was the invitation of the Vesey Club (Sutton) to one of the sectional meetings; this meeting was attended by Mr. J. B. Stone, Mayor of Sutton and Vice-President of the Vesey Club, and many of its members. A cordial invitation was given by the Vesey Club to the Geological Section to attend one of the Sutton Vesey Club meetings; such interchanges of courtesies are likely to bring forth much lasting good.

The following papers have been read at the meetings:—

January 17th.—"Notes on Serpentine Rocks," by MR. T. H. WALLER, B.A., B.Sc.
February 21st.—"Holiday Tours in Wales, &c." (illustrated by lantern photographs), by MR. C. J. WATSON.
March 20th.—"Holiday Tours in Switzerland and Germany," (illustrated by lantern photographs), by MR. C. PUMPHREY.
April 17th.—"Method of Separating Minerals by Heavy Solutions," by MR. T. H. WALLER, B.A., B.Sc.
June 19th.—"The Red Rocks of the Birmingham District," by Professor LAPWORTH, LL.D., F.G.S., F.R.S.
October 16th.—On "Rock Specimens recently brought from Norway by Mr. C. Pumphrey," by MR. T. H. WALLER, B.A., B.Sc.
November 20th.—On "The Bath Oolite, and the Method of Quarrying," by MR. A. BROWETT.
December 18th.—"Note on a Lithia-bearing Granite," by MR. T. H. WALLER, B.A., B.Sc.

SOCIOLOGICAL SECTION (President, W. R. Hughes, F.L.S.; Secretary, Herbert Stone).—A total of twenty-six meetings

has been held, of which ten were ordinary, fifteen supplementary, and one excursion. At the ordinary meetings the following papers have been read :—

January 24th.—On "Egoism *v.* Altruism and Altruism *v.* Egoism," by MR. A. BROWETT.

February 28th.—On "Trial and Compromise," by MR. W. K. PARKES.

March 27th.—On "Absolute and Relative Ethics," by MR. W. K. PARKES.

April 24th and June 26th.—On Prof. Fiske's "Cosmic Philosophy," by MR. F. J. CULLIS, F.G.S.

October 23rd.—On Herbert Spencer's essay on "The Ethics of Kant," by MR. HERBERT STONE.

November 27th.—On "Modern Railways," by MR. W. P. MARSHALL, M.I.C.E.

The average attendance at these meetings was twelve.

At the supplementary meetings the following papers have been read :—

February 18th.—On the "Genesis of Science," by MR. F. J. CULLIS, F.G.S.

March 1st.—On "The Origin and Function of Music," by PROF. ALLEN.

March 22nd.—On "First Principles," by MR. W. R. HUGHES, F.L.S.

April 5th.—On "Ultimate Scientific Ideas and Ultimate Religious Ideas," by MR. A. BROWETT.

April 19th.—On "The Relativity of all Knowledge," by MR. W. B. GROVE, M.A.

May 3rd.—On "The Reconciliation," by MR. HERBERT STONE.

May 17th.—On "Philosophy Defined," by MRS. BROWETT.

June 7th.—On "Progress: its Law and Cause," by MR. W. R. HUGHES, F.L.S.

June 21st.—On "The Data of Philosophy," by MISS DALTON.

October 4th.—On "The Progress of Evolution," by MR. W. R. HUGHES, F.L.S.

October 18th.—On "Space, Time, Matter, Motion, and Force," by MISS BYETT.

November 4th.—On "The Transformation and Equivalence of Forces," by MR. W. K. PARKES.

November 17th.—On "The Indestructibility of Matter, the Continuity of Motion, and the Persistence of Force," by PROF. POYNTING.

December 6th.—On "The Transformation and Equivalence of Forces," by MISS GOYNE.

December 20th.—On "The Direction of Motion," by MR. A. BROWETT.

The average attendance at these meetings has been thirteen.

On Saturday, July 28th, the members and friends of the section made their eleventh excursion, this being to Evesham to visit Simon de Montfort's country. On this occasion Mr. Howard Pearson read a very interesting paper on Simon de Montfort; and Mr. Slatter of Evesham, one on the geology of the district.

The section has suffered much loss from the absence of Mr. F. J. Cullis, who resigned the position of secretary on September 25th; also from the resignation of Dr. Hiepe, who has left the district permanently.

The Library.—The librarian (J. E. Bagnall, A.L.S.) reports that the Library is in a good condition. The issue of books during the past year has been as follows:—Botany, 30; Zoology, 5; Entomology, 6; Geology, 13; Microscopy, 13; Philosophy and General, 32; total 99, being 82 less than last year. The number of persons borrowing books during the year has been 26, as against 38 in the previous year.

General Property.—The Curators (G. M. Iliff and Herbert Miller) report that the microscopes and apparatus continue in good order, an improvement having been effected during the year in the "Collins' microscopes" by the removal of the side shields of the eye-pieces. A number of microscopic slides of vegetable sections have been presented to the cabinet by Mr. C. J. Watson.

IN SHERWOOD FOREST.

BY OLIVER V. APLIN,

MEMBER OF THE BRITISH ORNITHOLOGISTS' UNION.

The three species of the genus *Phylloscopus*, aptly termed "leaf-warblers," which are annual summer visitors to England, differ very considerably in their distribution in this country. For while the Willow Wren is diffused throughout the length and breadth of the land, becoming only slightly less abundant in the west, and the Chiffchaff is widely spread over all but the northern counties, the range of the Wood Wren is far more restricted, and this species can only be characterised as local in a high degree. In nowise a southern bird, it is indeed reported as abundant in the five counties which form the north of England, while the forest districts and the more wooded parts of the country, as far as the south coast, also afford it a home.

One thing is a *sine quâ non* in the character of a country side, if the presence of the Wood Wren is to be insured, viz., a more or less wide extent of woods; and, in my experience, those consisting chiefly of oak are preferred. In such

situations I have met with it in Warwickshire and Devonshire, but nowhere in such plenty as in one locality along the banks of the Thames in South Oxfordshire, and in Nottinghamshire in those great woods which now cover a part of the district which was formerly the noted Sherwood Forest. Here under the able tutorage of a resident friend (a well known field-naturalist, who has paid especial attention to this species), I first became well acquainted with the interesting and peculiar habits of these delicate little birds.

The woods are for the most part composed of oak of various ages, interspersed in places with remarkably fine larch and with plantations of Spanish chestnut. Where the timber is of older growth the wood is rather open, and here the ground underfoot is less deeply covered with dead leaves than in the thicker portions, and the bracken and bilberry grow, while little open glades here and there are clothed with heather and bracken. On the edges we have hollies and rowans, and the ground in spring is blue with wild hyacinths.

On entering the wood in the breeding season one soon hears the sibilant song of the male Wood Wren, and presently we catch sight of him flitting about the tops of the leafy oaks, pausing every minute to run through his simple and very remarkable song with shivering wings. Now he utters his call note, *twee twee twee*, as he sidles along a branch, or flutters in the air for a moment to catch a passing gnat or snatch some tiny insect from an oak leaf just out of reach, then he sings again. If it is late enough in spring for the Wood Wren to have eggs, and you notice the male very loth to leave a certain spot, constantly returning to the same tree, you may be pretty sure that somewhere at or near the foot of it his mate is sitting on her nest. Should she come off to feed or be frightened off, you will be instantly apprised of the fact by her deep plaintive single call note, *wee-eep*, totally distinct from that of the male. The Wood Wren is a late breeder, not having eggs in these woods in the first days of June, 1887, nor even nesting there at the end of May in the following year, though two or three days later I saw a nest containing seven eggs in South Oxon. In Sherwood the nest is placed upon the ground, among the dead leaves and bracken; in younger woods, where the trenching remains, it is often on the side of one of the little banks thus formed. It is wonderfully well hidden, and the hen bird seems well aware of this, for unless you happen to walk right on to the nest she will not fly off until you have passed it. The finding of Wood Wrens' nests in these woods is, therefore, rather an art, and the following plan for doing so was detailed to me.

You have first to find a cock bird in song, and mark the tree to which he continually returns after little excursions in search of food. Somewhere under or near that tree the hen is sitting on her nest; your business is to frighten her off. My host uses a pocket-handkerchief tied to the end of a long stick, with which, by waving it to and fro about a foot from the ground, he can beat some extent of ground. Most probably the hen will slip off unobserved, but you will know at once when she has left her eggs, as her call note will be heard, and the cock will cease singing and go to her. The nest-hunter must then hide behind a tree-trunk, and keeping his eye on the hen bird, patiently watch until she goes on to the nest again. After flitting about for a time, she descends from the tree tops, and presently drops suddenly down to the nest and disappears. Haply you have marked her in, but very often she slips on unobserved, and you only become aware of the fact from hearing the cock resume his song; in this case the whole process has to be gone over again. In South Oxon, where the woods are of a different nature, the nests are more easily found. A nest taken in Harlow Wood, in my possession, is composed of large grasses, bracken, dead leaves, and a little moss, and is lined with finer grasses, not hair, as stated by some authors, a fact first noticed, I believe, by my cicerone.

The Nightjar is pretty common in these woods, frequenting the little open glades, especially on sheltered slopes, where among the heather and bracken it finds a secure resting-place during the day. In such situations the hen deposits her grey-marbled eggs on the ground. When flushed in the daytime they flit away with their peculiar glancing, buoyant flight, but seldom go far, and generally alight again on the ground. But occasionally they will perch on the branch of a tree, sitting, as is their invariable custom, lengthways upon it, when they are very inconspicuous. The way these long-winged birds will twist in and out through the branches of a low oak, when one happens to be in their line of flight, is really wonderful. Large white spots on the outer tail feathers of the male, very conspicuous in flight, serve to distinguish the sexes at first glance. The best view I ever had of a Nightjar on the ground was here, when an individual, which we flushed among some young timber, settled on an old green ant-hill at the foot of an oak only a few yards from me. Those great wood-ants, by the way, are most formidable creatures, capable of inflicting a sharp bite. They are very numerous in parts of this stretch of wood, and the keepers search eagerly for their nests in early summer for the sake of the ants' pupæ cocoons,

or "eggs." so essential to the health of young Pheasants. There must be something very attractive to Nightjars in Thieve's Wood, for the only example of the Egyptian Nightjar ever known in Great Britain was shot here.

Not very many species of birds will be found in the deeper parts of the woods (this particular stretch consisting of two, separated only by a road, covers about 850 acres), but on the outskirts Tree Pipits like to breed, and are common. and some of our woodland warblers and finches, together with members of the thrush and tit families, will be noticed. In cold spring weather, however, it is pleasant to penetrate far into the thick warm wood, where. save for the waving of the tree-tops, you forget the searching east wind outside. The laughing cry of the Green Woodpecker is often heard, and the naturalist's attention may sometimes be attracted by a little heap of chips at the foot of a tree, which leads to the discovery of a freshly-hewn hole in the trunk. The Greater Spotted Woodpecker is also found sparingly, but I have only once met with it. The old woodpecker holes are a godsend to the ubiquitous Starlings, which occupy most of them to the exclusion of other birds, the noisy chattering of their young broods being a common sound as one strolls through the forest in late spring. Perhaps it is this usurpation of available holes which induces the Redstart to place its nest in this locality (where natural nesting sites should be plentiful) among dead leaves and bracken on the ground. I have examined a nest in this unusual position, and others have been known. The Woodpigeon or Ring-Dove is naturally plentiful, and a few pairs of Jays may be noticed, though the remains of far more adorn the keeper's gallows, while in winter that northern freebooter, the Hooded Crow, is a frequent and numerous visitor.

The Woodcock, of which a few pairs occasionally remain to breed here, deposits its eggs in a rudely-formed nest among the dead oak leaves, which match in tint the bird's russet plumage—a beautiful illustration of that protective colouring to which so many ground-breeding birds trust for the safety of their eggs and newly-hatched young. In some parts large holly trees grow freely. When I first knew the woods, some five years ago, these were green and flourishing, but most of them have been killed since then by the rabbits, which have increased, gnawing the bark during the late severe winters. Under the spreading branches of glossy leaves the Woodcocks found in winter a warm and sufficiently darksome retreat in the daytime. Notoriously eccentric in its choice of winter quarters, the Woodcock visits Thieve's Wood in

considerable numbers (while these notes were in progress I heard of five forming part of the bag made in the middle beat one November day), but in Harlow very few are ever found, albeit only a road separates the two woods. The hollies which still survive, are utilised by another and very different bird, which builds its nest in them, viz., the Blackcap, whose clear sweet notes may often be heard there in May. At the extremities of the branches, among the dark green prickly leaves, it forms its nest, which doubtless often escapes observation from its position. It is easiest to see the nests by creeping under the tree and taking observations from inside. I have seen the Blackcap's nest in a similar situation in Berkshire, and in one such found a clutch of the beautiful salmon-pink variety of the eggs.

The Lesser Redpole, best known as a winter visitor to the south, is not uncommon on the outskirts of the woods, where it forms the beautiful, warm, cup-shaped nest, destined to hold that clutch of eggs so entirely *Fringilline* in character, and yet so small—something like miniature Linnets' but with a bluer ground colour. The naturalist who has watched them in winter restlessly flitting about the heads of the alders along the banks of the half-frozen streams, or clinging to the slender leafless twigs of the birches in copse and shrubbery, gladly renews his acquaintance with these tiny linnets in their summer haunts. The birches which, with the alders, furnished their favourite food in winter, still possess attractions for them, and on some branchlet gently swayed by the breeze, amid the delicate waving green leaves of this most elegant tree, the cock Redpole loves to sit and sing his sweet twittering strain. Sometimes, too, a pair of Red-legged Partridges are detected as they run among the dead bracken and heather in the thin open wood. These birds have become numerous of late years, and seem to prefer the edges of woods, rough ground generally, and the open, heathery, forest land, to the cultivated fields. But they certainly have not interfered with the increase of the Grey Partridge. The cultivated land, with its light sandy soil and extensive turnip and seedgrass fields, which lies around and encroaches upon the remnants of the once great Sherwood, can almost vie with the best parts of Norfolk in the production of "birds." Late in May, when leaning at evening over the gate of one of the great seed-fields, which, in cold springs, are bitten rather bare by the sheep, I have counted six or seven breeding pairs feeding out on the short turf, within a short distance of one another; and in walking across my friend's paddock we have put up as many as half-a-dozen pairs.

(To be continued.)

MICRO-CHEMICAL METHODS FOR THE EXAMINATION OF MINERALS.*

BY MR. T. H. WALLER, B.A., B.SC.

The difficulties of the geologist who undertakes the examination of rocks in thin slices by means of the microscope are so great, and the determinations at which it is possible for him to arrive are so frequently based on evidence which it is a matter of extreme difficulty to present to others whom he may wish to convince, that he is sure to hail with delight any fairly simple and accurate means of settling by actual analysis, even though it may be on a very minute scale, the composition, and hence the nature, of the mineral components of any rock he may have under his observation. Optical methods of research have of late years made extraordinary advances. The apparatus for observing the effects of a minute crystal section on converging polarised light, and hence of coming to a conclusion as to the position of the optic axes of the crystal, whether the crystal is uniaxial or biaxial, and whether the double refraction is positive or negative, enables us in many cases to discriminate between minerals which present a very similar aspect when reduced to thin slices—*e.g.*, quartz and clear felspar. That purely optical methods do not, however, always lead different observers to the same results, may be seen from the correspondence as to the nature of a certain constituent of some of the serpentines of the Lizard district which appeared in the "Geological Magazine" last year. And yet the difficulties in the way of an analysis are considerable. Of course where the crystals are of such a size as to be separable by careful breaking out, and are in sufficient quantity, a quantitative analysis by the ordinary methods of the laboratory is possible, and is the best possible procedure. Where the "grain" of the rock is moderate, it is still possible, when the mass has been crushed to a tolerably even fineness, to separate the constituents by means of some of the heavy salt solutions which are prepared for the purpose, such as the double iodide of mercury and barium, or of mercury and potassium, and make a chemical examination of the different parts. By this means most valuable results are obtained, and it is not necessary to do more than refer to almost any thorough examination of a rock published in the geological journals to show the importance of the procedure.

* Read before the Birmingham Natural History and Microscopical Society, October 18, 1887.

What is, however, perhaps even more to be desired by the working petrologist is the power to decide in a short time and without a quantitative analysis, the material for which can often be obtained only by a series of very laborious and tedious operations, and, indeed, is often quite out of his power to obtain at all, as to the nature of a particular mineral grain which he may come across in the course of an investigation. Any analysis in this case must naturally be qualitative rather than quantitative, and must also of necessity be on a very minute scale, and it is with a short account of a few special methods devised for this purpose that I have the honour of occupying your attention this evening.

The first method I have to mention has specially for its object the discrimination of the various members of the felspar group. It was devised by Dr. J. Szabó, of the University of Buda Pesth, and depends on observations of the fusibility of grains of the substance in certain definite positions in the flame of a Bunsen burner, and on the flame colouration produced.

In order that observations may be comparable, exact attention must be paid to the dimensions of the burner, the height and character of the flame, the thickness of the platinum wire which is used as a support, the position of the assay in the flame, and the duration of the experiment. The experiments are three:—Firstly, 5mm. above the burner in the outer zone of the flame; secondly, 5mm. above the chimney shield; and, thirdly, in the same position as the last, but with the addition of a small quantity of gypsum to act as a flux, and render more of the alkalis volatile. During each experiment the flame is observed. The intensity of the yellow, due to soda, is estimated according to the scale given, and then the soda flame is eliminated by means of observing through glass coloured a deep blue by cobalt, and the violet colour, due to potash, similarly valued. The experiment lasts 1min. in the first two cases, 2min. when the gypsum has been added. At the end of the minute the assay is removed from the flame and examined through a lens for evidences of fusion. There will, in some cases, be only a very slight rounding of the sharp corners, at others a more or less complete fusion. The appearance of the grain is also observed with regard to the bubbles which form in it either in the interior or on the surface, and also for the condition of the surface, whether glassy or enamel-like. From the sum of these observations it is possible to arrive at very accurate results, but for the particulars I must refer to the original memoir. Anyone, however, may gain a very considerable

mastery of the method by comparing known felspars placed simultaneously in the flame, on opposite sides of it, and observed together. In this way the distinction of anorthite from labradorite becomes quite easy, and the soda percentage of an orthoclase may be estimated with considerable approach to accuracy.

The second method I have to speak of is of somewhat limited application in certain ways, although it is applicable to other minerals than the felspars.

It is that adopted by Dr. E. Bořicky, of Prague, who explains that he could not use Szabó's method because there was no gas supply at his disposal. He decomposes the mineral with a dilute solution of fluosilicic acid on a glass slide, which has been evenly covered with a coating of hard Canada balsam, and after allowing 24 hours for the decomposition, allows the drop of reagent to evaporate as far as it will, in a dry, slightly warm place, and examines the forms of the fluosilicates which are left. Some of these are highly characteristic—the potash salt crystallises in brilliant octohedra, variously modified; while the soda compound, which is somewhat more soluble, and is therefore not quite so readily crystallised, separates in short, stout, hexagonal prisms. Unfortunately the determination of lime is not so certain, the forms due to it being less definite and liable to modification in presence of soda. The fluosilicates of protoxide of iron and of magnesia have the same crystalline form, and are both quite soluble in water, so that they are not very easily obtained, and can only be distinguished from each other by exposing them to the action of either the vapour of sulphide of ammonium, which blackens the iron salt, or of chlorine, which reddens it.

On the whole, I think this method may be said to be superseded by the processes to which we now come. Details of the tests differ, but the principle is—decomposition of the mineral by either hydrochloric, sulphuric or hydrofluoric acid, according to the necessities of the case, and the subsequent examination, mostly by precipitation methods, of the solution thus obtained.

The decomposition may be effected directly on a section picked out by the microscope and isolated by means of a hole of suitable size, made either in a cover glass or where hydrofluoric acid is to be used in a piece of platinum foil. This is cemented on to the section with balsam, the hole must be cleared of balsam, and thoroughly cleaned with spirits of wine, and the mineral grain thus exposed can be subjected to the action of the acid, which should be led into the

hole from one side by means of a fine wire, so as to avoid the formation of air bubbles. The preparation must be gently heated, a tin box full of hot water, with a lid on which to lay the glasses, answers well; and when the first quantity has evaporated, a second, and, if necessary, a third and fourth drop may be added. Finally the acid is replaced by water, and the soluble salts removed by a very fine pipette made of a piece of narrow glass tube drawn out to a very fine point. This solution is then distributed into separate drops on a glass slide, and the further examination proceeded with.

If a minute grain can be separated, the decomposition of it may be effected in a little platinum spoon, such as is used in blowpipe analysis. The action of the acid is much facilitated by the fine grinding of the specimen to be examined. This should be effected either on a polished steel anvil with a polished steel pestle, using a ring of glass to prevent the dispersion of the powder, or in an agate mortar. If porcelain were used the abrasion of the mortar might occasionally introduce sufficient impurity to falsify the results of the subsequent tests.

The hydrofluoric acid may be replaced by fluoride of ammonium, which can now be procured in a state of very great purity. In this case, however, the residue of salts must be heated to redness, in order to be sure of getting rid of all trace of ammonia, as this, by the similarity of its reactions, might easily be taken for potash. The action also is said to be less energetic than that of hydrofluoric acid, so that probably the acid is the better of the two, although being solid the salt is by far the more convenient. In any case when the fluoride compounds are dried up, or nearly so, a drop of sulphuric acid, diluted somewhat with water, must be added, and the whole again gently heated. If the sulphuric acid has been added in sufficient quantity the excess will be driven off in a dense cloud, and if this does not take place another drop must be added, and the evaporation repeated. It is advisable not quite to dry up the mass of salts, as when quite dry they dissolve in the water which is next added with much greater difficulty.

If the operations have been successfully performed, we shall have a solution of all the bases of the mineral in combination with sulphuric acid, and, as before stated, this must be distributed in drops on to glass slips by means of a finely drawn out glass tube.

If one of these drops is allowed slowly to evaporate, and is observed from time to time with a power of about 100, the presence of *Lime* will be shown by the formation in the drop,

and especially at the edges of the very characteristic needles or blades of gypsum, showing the proper angles of the clinopinacoid of the crystals, and occasionally the arrow-head twin which is so frequent among the larger natural crystals. Behrens speaks of this test as of extreme delicacy, and says that it is capable of showing $\frac{1}{2000}$ mgr. of lime. To another drop add at one edge a fragment of bisulphate of potash, unless you feel inclined to pay for the corresponding salt of cæsium, which, however, is decidedly more delicate as a test. In presence of alumina the octohedra of potash (or cæsia) alum will begin to appear almost at once, and are quite unmistakeable. As the potash alum only contains about 10 per cent. of alumina, and the cæsia salt only about 9 (the latter, moreover, is very much less soluble in water), the delicacy of the reaction is considerable. In cases where potash and alumina are both present in the mineral under examination, as *e.g.*, in the case of an orthoclase, or a rock containing orthoclase, the presence of both bases may be shown by the crystallising out of the alum along with the needles of gypsum.

At a distance of about $\frac{1}{8}$ of an inch from another of the drops place a drop of a solution of chloride of platinum, and allow the drops to run together and gradually mix. The presence of *Potash* will be shown by the almost immediate appearance of the double chloride of platinum and potassium in orange yellow octohedra, variously modified about the angles. Where only minute proportions of potash are present the distinguishing crystals may only appear on the partial evaporation of the drop. If the bases have been dissolved as chlorides of the various metals, the reaction for potash is more rapid, but the crystals are less perfectly shaped.

To test for *Soda* we may use either the acetate of uranium, as suggested by Streng, or sulphate of cerium, as preferred by Behrens. The former reagent must be added to the dried residue of a drop of the solution of the bases slightly evaporated, and observed on cooling. In the presence of soda distinct yellow tetrahedra of the double acetate of sodium and uranium separate. They contain less than 6 per cent. of soda, and therefore show a very minute quantity of this base, but the test cannot be applied in the presence of free sulphuric acid, even of a mere trace, and is also liable to be obscured by the formation of crystals of the acetate of uranium, or of a basic acetate. A little practice, however, will enable very good results to be obtained.

In solutions of the sulphates the addition of a concentrated solution of cerous sulphate (the yellow *ceric* sulphate is of no

use) produces the precipitation of the double sulphate of cerium and sodium, in the form of a cloud of minute granular masses, without any distinct crystalline form. Potash produces a similar double sulphate, but it separates somewhat later and in much larger granules. Behrens describes them as somewhat similar in appearance to the starch grains of potato. The reaction is obviously the usual one adopted for the separation of the cerium metals, and as the other bases which usually accompany ceria form similar compounds with the sulphates of soda and potash, though not so readily, the purity of the cerous sulphate is not imperative—an important fact, as the salt which is to be obtained of the dealers in chemicals mostly contains a quantity of the allied bases, the purification from which is a difficult matter.

For *Magnesia* we test by adding a drop of dilute hydrochloric acid, then dilute ammonia, and then connecting with the drop by a narrow channel another drop of water in which has been placed a small lump of microcosmic salt. The distance of the drops should be about $\frac{1}{8}$ of an inch, the reason being that the slow mixing of the solutions is essential to the formation of the characteristic crystals, different at the two ends, of the phosphate of magnesia and ammonia. In the presence of iron and alumina we must wait after the addition of ammonia till these bases are precipitated, and they then do not interfere.

Reciprocally, an ammoniacal solution of magnesia may be used to test for *Phosphoric Acid*. As, however, we have frequently to test for this acid when occurring in apatite crystals, which are so enveloped in other minerals that the products of decomposition and solution are mixed together, recourse is frequently had to a solution of molybdate of ammonia in nitric acid. The mineral should be attacked with nitric acid, and the solution mixed on a glass slip with the molybdic solution. The presence of phosphoric acid is shown by yellow octohedra and rhombic dodecahedra of the ammonic phosphomolybdate.

Our tests of *Lithia* are not very satisfactory, but carbonate of potash is said to give fair results. On the other hand very small proportions of lithia are easily distinguished by means of the spectroscope — even one of the small direct vision spectroscopes which are made for the pocket. A fragment of the mineral heated with gypsum in the zone of fusion of the Bunsen burner shows at once the intense red line, lying between the principal lines, due to soda and potash. The carmine colour, which pure lithia salts impart to the flame, is completely masked by a very minute quantity of soda, but

may be recognised on examining the flame through a solution of indigo instead of through a blue glass, as when testing for potash. The glass cuts off the lithia flame as well as the soda flame, but through the thinner parts of the indigo solution, which completely stop the yellow light due to soda, the lithia flame is still visible, but gradually disappears before the thicker parts are reached.

With the help of a pocket spectroscope I have detected lithia in the great majority of micas from granites which I have examined. not only in lepidolites, but even in dark micas which would, no doubt, come under the division of the biotites.

It is obvious that before coming to any conclusions on the constitution of a mineral by these micro-chemical methods. the reagents used must be most carefully tried by blank experiments, so that we may be quite sure that there is no trace present of the base the presence of which we wish to determine. For instance acetate of uranium, as usually bought, must be recrystallised, and probably twice over, before it ceases to show on evaporation the yellow tetrahedra due to the presence of soda. Chloride of platinum must be carefully examined as to the absence of potash (or ammonia), which would make itself unpleasantly manifest on slight evaporation. The best method for purifying this reagent is to dissolve the solid salt in as neutral and dry a state as possible in absolute alcohol, filtering off any small quantity of undissolved double salts and evaporating the filtrate to get rid of the alcohol.

In the next place it is of course essential for the beginner to proceed methodically—testing, first, known salts of the various bases, then known minerals. Fragments of the different felspars, augites, hornblendes, micas, &c., of which the composition is at least approximately known, should be first examined, and the results obtained compared with those of the ordinary analysis. The student is then in a position to proceed to the examination and determination of minerals in a rock; first of all, those which he can detach as being more easily manipulated; finally, as he acquires practice with small quantities of material, attacking the cases where only a thin section is available and the grain has to be isolated by means of a perforated screen as above described.

In conclusion, I may refer to my authorities:—

Szabó, "Ueber eine neue Methode die Feldspathe auch in Gesteinen zu bestimmen." Buda Pest, 1876.

Bořický, "Elemente einer neuen chemisch-microscopischen Mineral-und Gesteinsanalyse." Prag., 1877.

Streng, Neues Jahrbuch für Mineralogie und Geologie. 1885, I., p. 21.

Behrens, "Chemical News." 1886, Oct. 15 to Dec. 24.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from Vol. XI., page 307.)

Midland Counties Herald, August 5th, 1888.

"Remarkable plants observed growing spontaneously in the neighbourhood of Birmingham by Wm. Ick, Curator of the Birmingham Philosophical Institution." Worcester plants only included. The previous records of Dr. Ick and Miss Beilby omitted.

Aconitum Napellus. Meadow at Northfield.

* **Turritis glabra.** Near Stourbridge.

Erysimum cheiranthoides. Caledonia, near Stourbridge.

Lepidium hirtum (*L. Smithii*). Near Stourbridge.

* **Thlaspi arvense.** Near Stourbridge.

Sisymbrium Sophia. Near Stourbridge.

* **Polygala vulgaris** (*P. depressa?*) Moseley Bog.

* **Stellaria uliginosa.** Stony Lane, Moseley.

* **Epilobium tetragonum** (*E. obscurum?*) Meadows beyond Vaughton's Hole.

* **Montia fontana.** Stony Lane, near the top.

* **Sanicula europæa.** Moseley Bog.

* **Adoxa Moschatellina.** Edgbaston Lane, near Moseley Hall.

* **Viburnum Opulus.** Moseley Bogs.

* **Valeriana officinalis** var. β. Stirchley Street, near King's Norton.

* **Dipsacus pilosus.** Meadow near the field path from the back of the Pebble Mill to Moseley.

* **Solidago Virg-aurea.** Halesowen Road.

* **Eupatorium cannabinum.** Edgbaston Lane, near Avern's Mill.

* **Pulicaria dysenterica.** Yardley, near the bridge.

* **Campanula latifolia.** Yardley, on the bank of the stream a little below the bridge.

* **Digitalis purpurea.** Banks around Moseley Common.

* **Narcissus Pseudo-narcissus.** Meadow near the National School, Moseley.

* **Juncus squarrosus.** Moseley Bog.

* **J. uliginosus** and var. *subverticillatus*. Moseley Bog.

* **Triglochin palustre.** Moseley Bog.

* **Eleocharis palustris.** Moseley Common.

* **Scirpus cæspitosus.** Billesley Common.

* Carex remota. Stony Lane, Moseley.

* C. ovalis. Near Stourbridge.

* C. riparia. Side of the Rea beyond Vaughton's Hole.

* Melica uniflora. Stony Lane, Moseley.

* Nardus stricta. Moseley Common.

Equisetum sylvaticum. Moseley Bog.

E. hyemale. Moseley Bog.

List of some of the rarer plants observed in the neighbourhood of Birmingham by Samuel Freeman, 11, Sun Street West, Birmingham. October, 1841.

"PHYTOLOGIST," JULY, 1842, 1ST SERIES, VOL. I., p. 261.

Worcester plants only included, and previous records by Dr. Ick and Miss Beilby omitted, except in the case of *Osmunda regalis*.

* Rhamnus catharticus. Yardley Bridge.

* Epilobium palustre. Moseley.

* Ribes nigrum. Yardley Bridge.

* Myosotis cæspitosa. Moseley.

* Carex ampullacea. Moseley.

* Aira præcox. Moseley Common.

* Danthonia decumbens. Moseley Common.

* Osmunda regalis. Moseley Common.

The "Phytologist" for March, 1848, Vol. I., pp. 508.514, contains lists of the Ferns and Fern Allies from the counties of Stafford, Warwick, and Worcester, contributed by the Editor, the late Edward Newman. The Worcester list includes, *inter alia*, the following records:—

* Cystopteris fragilis. In fissures of the Oolitic rock on the summit of Bredon Hill, on the side of the precipice; near Bromsgrove Lickey; E. Lees.

* Polystichum angulare. Near Clifton-on-Teme. T. Westcombe.

* Lastrea spinulosa. I used to find it in some of the bogs on Moseley Common, which I believe have since been drained. G. Luxford.

* Ceterach officinarum. Very sparingly on walls at Great Malvern, but not on the rocks of the hills, and I should say this fern is not at home in Worcestershire; E. Lees. Badsey, near Evesham; T. Westcombe.

* Osmunda regalis. Moseley Common; E. Lees, W. Southall, junr., D. Cameron, G. Luxford, W. G. Perry.

Lycopodium clavatum. On a Sandstone cliff by the Severn, at Winterdyne, near Bewdley, T. Robinson, from whom I have a specimen, E. Lees; bog on Hartlebury Common, R. J. N. Streeten; Moseley Common, W. Southall, junr.

Equisetum fluviatile. *(Var. of E. limosum.)* Plentiful in boggy woods near Worcester, Great and Little Malvern; indeed generally, E. Lees; near Worcester, T. Westcombe.

Mr. Newman's well-known "History of British Ferns," of which the first edition was published in 1840, and the second in 1844, contains no new Worcester records.

The Rev. W. L. Baynon, Rector of Seal, Surrey, who resided at Bewdley, in or about the year 1835, was a botanical correspondent of my friend, the Rev. J. H. Thompson, the present Incumbent of Cradley. He informed Mr. Thompson that, at that date, *Drosera rotundifolia*, *Erodium maritimum*, and *Radiola millegrana* were growing at Pedmore Common, near Stourbridge. They are not now to be found there. The localities of these, and other rare plants in the neighbourhood of Kidderminster and Bewdley, were communicated by Mr. Baynon to *The Ten Town's Messenger*, a newspaper published at Kidderminster at that time. I have not succeeded in procuring the paper containing Mr. Baynon's communication, and am therefore unable to incorporate his records in the present history.

(To be continued.) p 87

Review.

Catalogue of Canadian Plants. PART IV., *Endogens.* 8vo. By JOHN MACOUN, M.A., F.L.S., F.R.S.C.

THE first volume of this valuable work on the Canadian Flora was favourably reviewed in the "Midland Naturalist," Vol. X., p. 102, 1887. The excellent features of that volume are fully sustained in Part IV., which is the first instalment of Volume II.

In this part the Endogens are dealt with, and the enriched experience gained by the investigation of new districts is seen in the more copious notes on the distribution of each plant.

"Since the publication of Part III., extensive collections have been made by James M. Macoun on the shores and islands of James Bay. Dr. G. M. Dawson has made valuable and interesting notes and collections in that part of the North-West Territories bordering on Alaska. The writer (Prof. John Macoun) spent five months collecting on Vancouver Island, and gathered much valuable information regarding its flora. That part of this additional information which is applicable to the Endogens is included in the present issue."

As in the former volume, the editor has not relied exclusively upon his own individual judgment in determining and verifying critical or new species. The assistance is acknowledged of several of our best known experts, such as Dr. Sereno Watson, more especially in the Liliaceæ and Juncaceæ; Mr. Arthur Bennett, F.L.S., of Croydon, for assistance in the Naiadaceæ and Carices. The Rev. Thomas Morong, Mass.; W. H. Beeby, A.L.S.; and the veteran botanist, Dr. Vasey, have also rendered valuable assistance.

To the student interested in geographical botany, this work will present many features of great value, and will enable him more fully to appreciate the hypothesis, with regard to the spread of plants, so ably ennunciated by Sir J. D. Hooker, in his classical "Outlines of the Distribution of Arctic Plants," published in "The Transactions of the Linnean Society, Vol. XXIII., page 251.

The number of Endogens recorded as occuring in the Dominion is 747 species, and of these 170 are natives also of Great Britain or Ireland; many of these being our rarest northern and alpine plants, but some of them are the more familar plants of our woods, pastures, and waysides, so that the British botanist who visits Canada will. amidst much that is strange, now and again have his eyes gladdened by the presence of an old and familiar friend. The total number of Phanerogams recorded from the Dominion of Canada is 2,955, of these 2,208 are Exogens, and 747 Endogens.

The volume throughout bears evidences of careful work, close investigation, and unremitting industry; and the greatest care appears to have been used in discriminating the alien and casual plants from those that are truly native.

Two more parts will bring the work to a close, and as these will contain the Cryptogams their appearance will be looked forward to with much interest. Already over 2,000 species of named Cryptogams are now in the herbarium, and Prof. Macoun anticipates that this number will be increased to at least 2,500 species before the issue of the next two parts. Part V. will contain the ferns and their allies. with the mosses and liverworts, and it is intended in Part VI. to catalogue the lichens, fungi, and seaweeds.

The work is printed in bold type and on good paper, and when completed will form one of the most valuable and interesting of the American floras. J. E. BAGNALL.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SUPPLEMENTARY MEETING, Dec. 20. Mr. W. R. Hughes in the chair; twelve members present. Mr. Hughes gave a sketch of the history of the section. Mr. Browett gave his exposition of the ninth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Direction of Motion." An interesting and animated discussion followed. —BIOLOGICAL SECTION, January 8th. Present fifty members and friends. Mr. E. Catchpool, B.Sc., of Sheffield, read a remarkable paper on the "Flight of Birds and Insects," an abstract of which will appear in the next number. The paper was illustrated by excellent but simple models, by which each point of Mr. Catchpool's argument was demonstrated in turn.—SOCIOLOGICAL SECTION, SUPPLEMENTARY MEETING, January 10th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Stone exhibited a series of tail feathers from the common peacock, showing a gradual transition from the perfectly-formed, characteristic eye, to an almost bare shaft having only a few laminæ remaining, and these entirely confined to one side. Mrs. Browett gave her exposition of the tenth chapter of Herbert Spencer's "First Principles," entitled, "The Rhythm of Motion." Eleven members present.—SOCIOLOGICAL SECTION, Jan. 22nd. Four new members were elected. Mr. E. H. Wagstaff exhibited the head of *Attus aurora*, a very rare spider, from Penang, showing the

eight brilliant eyes. Mr. Cuming Walters then read his paper on "Tennyson's Country." He said that his object had been to examine the localities amidst which the poet had been born, and where he had laid the scenes of his earlier poems. Lord Tennyson was above all an English and an English-loving poet. The tone of his poems was essentially that of Lincolnshire, sombre in hue, but possessing quiet beauties of its own. The best time to see Lincolnshire was in the autumn, which was also the poet's season. The writer described Tennyson's birth-place at Somersby, and quoted references to it from "In Memoriam;" also the farmhouse close by, called a "grange" in Lincolnshire, which was inhabited by the original of the "Northern Farmer," and was itself Mariana's "Moated Grange;" and Holywell Glen, a gloomy hollow which was the scene of the "Lover's Tale," and doubtless suggested to the poet the dismal story of "Maud." He also spoke of the Lincolnshire characters who are pourtrayed by Tennyson:—his mother, described in the "Princess," the originals of Lady Clara Vere de Vere, Sir Harry Vane, and others. Tennyson's sea-pictures—even those of the "Lotos Eaters"—are mainly such as can be seen on the Lincolnshire and Norfolk coasts; his wild flowers and his garden flowers are those of Lincolnshire, and the influence of the county can be traced through all his early work. Mr. W. R. Hughes pointed out the Sociological importance of the subject, which was a particularly striking instance of the influence of the environment upon the organism, and thus Mr. Walters had perhaps been talking Evolution without knowing it.—Sociological Section, Supplementary Meeting, Jan. 24th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes announced that he had received a post card from Mr. Spencer in reply to a letter in reference to Prof. Pcynting's, in which he said that he had not read the article but could add nothing further to his reply to Moulton, published in the third volume of Essays. Also, that he had received a few copies of the "Modern Science Essayist," the organ of the Brooklyn Ethical Association, and suggested that some marks of sympathy should be sent to them from the Section. Mr. Stone gave his exposition of the eleventh chapter of Herbert Spencer's "First Principles," entitled "Recapitulation, Criticism, and Recommencement," in the absence of Mr. Grove, who was unable to attend. After which, he read extracts from Mr. Spencer's "Replies to Criticism," dealing with the points disputed by Prof. Poynting.—General Meeting, Jan. 29th. The President, Mr. W. B. Grove, M.A., occupied the chair, and there was a large attendance of members. Mr. W. P. Marshall, M.I.C.E., gave an interesting account of the masses of rock that fell recently at Niagara Falls, and exhibited a sketch showing the outline of the "Horseshoe" Falls previous to the fall of rocks and also of their present form. Mr. J. E. Bagnall, A.L.S., exhibited for Miss Gingell (who was present) *Hypnum Sommerfeldtii*, *H. abbreviatum*, *H. triquetrum* in fruit, *H. brevirostre* in fruit, and other rare mosses from Dursley, Gloucestershire. Mr. C. Pumphrey and Mr. C. J. Watson exhibited by the aid of the oxy-hydrogen lantern a large number of photographic views of objects and places of interest in Switzerland, Italy, the Channel Islands, Weymouth, Bath, and of the recent beautiful hoar frost on leaves and trees in this district, which were much appreciated by the meeting, and a hearty vote of thanks was passed to them.—Annual Meeting, February 5th. Mr. W. B. Grove (president) in the chair. There were also present Messrs. W. P. Marshall and W. H. Wilkinson (secretaries), J. Rabone (treasurer), J. Levick, R. W. Chase, J. F. Goode, Herbert Stone, W. R. Hughes, J. E. Bagnall, J. Edmonds, J. Udall, Kineton

Parkes, C. J. Wainwright, G. Hadley, C. Pumphrey, and J. Pumphrey. The annual report (which is printed in full at page 49) and the financial statement having been read, Mr. W. K. Parkes proposed the adoption of the report and financial statement.—Mr. W. A. Parker seconded the motion, which was carried unanimously.—On the proposition of Mr. Hughes, seconded by Mr. Levick, a hearty vote of thanks was accorded to the president for his services to the society during the past year. Votes of thanks were also passed to the editors of the Birmingham press for inserting reports of meetings, and to the officers of the society.—Mr. Grove was re-elected president for the year; Mr. Rabone was re-appointed treasurer, and Messrs. Wilkinson and Marshall general secretaries.—BIOLOGICAL SECTION, February 12th. Mr. R. W. Chase in the chair, among those present being Messrs. Bagnall, Grove, Hughes, Levick, Marshall, Pumphrey, and Wilkinson. Mr. Charles Pumphrey was elected president and Mr. Thomas E. Bolton as secretary of the section for the present year. Mr. Bagnall exhibited, for Miss Gingell, *Hypnum molluscum* and *Anomodon viticulosum*, from Dursley; also, for Miss Taunton, *Aristolochia bætica* and an *Arum* from Spain. Prof. T. W. Bridge, M.A., then gave a valuable and interesting paper on "The Structure and Function of the Air-bladder in Certain Fishes," illustrating it by means of many diagrams and skeletons of various fishes. A discussion followed in which Messrs. Pumphrey, Chase, Hughes, and Grove took part.—SOCIOLOGICAL SECTION, SUPPLEMENTARY MEETING, Feb. 14th, in the Society's room. Mr. W. R. Hughes, F.L.S., in the chair. The minutes of last meeting being read and confirmed, the President read a letter from Mr. Spencer calling attention to an essay by a German author, Dr. Karl Kinderman, on the "Entwickelungslehre of H. Spencer;" the first sign of recognition of the Synthetic Philosophy in the land of Kant. Also, a letter from M. Grosclaude, of Paris, announcing his failure to keep the Parisian Sociological Society afloat, attributing his lack of success to the want of thinking persons, and to the unsettled political condition of the country. A translation of the letter was entered on the minutes. The President also announced the receipt of the Second Part of the "Modern Essayist," from the Brooklyn Ethical Association. Mr. Kineton Parkes read his paper on "Evolution and Dissolution," being an exposition of chapter twelve of Herbert Spencer's "First Principles." The subject, which was ably treated, was afterwards discussed.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 17th. Mr. Deakin exhibited *Pandora inæquivalvis*, a marine shell from Bournemouth. Mr. Cracroft described a new method of making drawings of objects to be used at soirées, etc., by Dr. Hudson. The drawing is made on tissue paper and pasted over a circular hole in brown paper. A series of these is fastened in a frame and a light placed behind, when a good effect is produced. A drawing made and mounted in the manner described was handed round.—December 31. Mr. J. Corbet showed a collection of ammonites and other fossils from the Inferior Oolite of Cheltenham; under the microscope, Mr. J. Collins, leaf of *Niphobolus lingua*; Mr. J. W. Neville, anthers and pollen grains of the Japanese hibiscus.—January 7th. Mr. J. W. Neville exhibited the skin of a large Australian snake; Mr. J. Corbet, a small collection of plants from the bush of South Africa.—January 14th. Mr. J. W. Neville showed specimens of ammonites, whole and in section, from Whitby; Mr. J. Betteridge,

male and female specimens of Pallas' sand grouse, *Syrrhaptes paradoxus*, shot at Rednal on December 29th; Mr. J. Madison, fossil impressions of leaves from Bournemouth and Alum Bay, Isle of Wight; Mr. J. Corbet, a large collection of fossils from the Leckhampton Hills; Mr. Moore, a series of sections of fossil woods under the microscope.—January 21st. A general exhibition to which the public were invited. There was a large attendance, and the following exhibits were made by the members:—A number of lantern slides of photo-micrographs of insects and other objects, by Mr. J. Edmonds; photo-micrographs of rock sections, by Mr. T. H. Waller; photographs of orchids and other plants, by Mr. C. Pumphrey; and a series of hand-painted slides, illustrative of pond life, by Mr. J. W. Neville; Messrs. J. Betteridge and P. T. Deakin, a collection of British birds, and specimens of Pallas's sand grouse; Mr. Deakin also showed a collection of Wenlock and Lias fossils; Mr. H. Hawkes, a mounted collection of marine algæ, with drawings of their sporangia; Mr. Camm, a collection of eighty specimens of fungi of the orders Myxomycetes and Discomycetes; Mr. J. Madison, cases of English and foreign land and freshwater shells; Mr. Corbet, fossil leaves from Bournemouth; Mr. Barradale, cases of English and Chinese insects; Mr. C. P. Neville, cases of English and foreign butterflies and moths; and Mr. J. Collins, a collection of local plants. Under the microscopes a series of living and other objects were shown, many deserving of special mention. During the evening a short address was given on the aims and objects of Natural History Societies.—January 28th. Mr. J. Betteridge presented to the Society specimens of the following birds prepared for the cabinet:—Carrion crow, wryneck, common snipe, jack snipe, brambling finch, and chaffinch, for which the thanks of the members were given; Mr. H. Hawkes showed furcated feathers of pigeon, also some in which the barbs appeared to be eaten away, and in their place a growth possibly of fungoid origin. Mr. J. A. Grew then read a second paper on "Insect Mimicry." The writer said the paper would show why insect mimicry was resorted to, and why, in some instances, it was not required. The first cause of mimicry was protection, and an insect was justified in using such an artifice; several instances were given of insects adapting their colour to their surroundings. Not only was colour concerned, but shapes were equally important factors. The mimicry of some insects was confined to the larval stage, the imago throwing off all disguises. The writer said insects had not always enjoyed these advantages, but that long ages had been required to develope those features that would best enable them to secure food and avoid being made food of by others; the results of natural selection had been transmitted in an improved degree through long periods of time.—February 4th. Mr. H. Hawkes read a communication from Mr. W. Tylar, in which he presented six dozen micro. slides to the cabinet of the Society. A hearty vote of thanks was passed; Mr. H. Hawkes, exhibited under the microscope the orange scale coccus, *Lecanium hesperidum*, also *Coccus aceris*, and gave a short account of their life-history; Mr. J. Moore, raphides, etc., in bulb of *Narcissus polyanthus*; Mr. J. Collins, *Draparnaldia glomerata*, with some remarks on the mounting of the same.—February 11th. Mr. C. P. Neville gave a lecture on "Aberystwith and how to see it." The lecture described the scenery of the town and surrounding country. It was profusely illustrated by a series of photographic views, taken during a number of visits to the locality, shown by the lime light.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.*

Before entering upon the subject proper of my address this evening, I wish to say a few words upon some topics relating to our Society, and also to seize this second opportunity of performing a duty which I am fully sensible I owe, and which I have already tried partially to discharge. Let me take the second item first, and say that I feel it no less a pleasure than a duty to thank the members, and especially the Council of this Society, for the honourable position of President which they have assigned to me, and which, I know, I could not have adequately fulfilled, unless I had carried with me throughout the year their goodwill and assistance in the work.

When, at the beginning, I looked back upon the long and illustrious line of men of science and naturalists who have in turn occupied the leading place in this Society, I must confess my heart sank within me at the thought that I could do so little to rival the glories of the past. When I read the names of those who have, in years gone by, filled—yes, actually and literally *filled*—this presidential chair, and calculated by the aid of astronomical observations and the Differential Calculus how small a portion of its superficial area I myself was able to conceal, I was irresistibly reminded of that dark saying of old:—"Behold, there were giants in those days."

Think of our old and veteran commander, the one who first led the nascent Society from its cradle, and for three successive years tended its infantile and toddling footsteps, and to whose fostering care in after years we all know much of its success was due—need I say I refer to the George Washington of our tiny republic, the enthusiastic President of the Sociological Section? But, much as you all respect and admire Mr. Hughes, and look back with satisfaction on his long and useful association with our labours, I think it has unaccountably been reserved for a lucky thought of mine to discover that this year Mr. Hughes has to celebrate the Silver Wedding of his connection with our Society. It is now exactly twenty-five years since the title, "The Birmingham Natural History Society," came into existence. We ought not. I feel sure, to let this year slip by without in some

* Read before the Birmingham Natural History and Microscopical Society, March 5th, 1889.

suitable manner commemorating an event which does equal honour to Mr. Hughes and to the Society. We all remember how, some time ago, John Bright celebrated the Silver Wedding of his union with Birmingham, and surely it is not less fitting that we should mark with equal emphasis, so far as our power permits, a similar occurrence in the life-history of our first and four-times President.

It needs not that I should pass in particular review the names of the Presidents who have succeeded him; in Mr. Allport, Mr. Marshall, Dr. Hinds, Mr. Wills, Dr. Crosskey, Dr. Deane, and Mr. Lawson Tait, not to mention others more recent and better known to the present generation, we have a list of which any society like ours might well be proud. About the Society itself, it is a great pleasure to be assured, by the concurrent testimony of all whom I have spoken with, that, on the whole and taking into account the position in which we are placed, there is little to be desired except an increase in the membership. It should always be kept in mind that one of the objects of such a Society as ours, is the mutual pleasure as well as the profit of the members. Of course, we also keep before our eyes the advancement of Natural Science in the abstract, and are ready to do all we can to contribute to that end; moreover there can be no question that our Society does afford needful help in that direction, if only by providing opportunities for that study of books and mutual discussion in which the solitary student finds himself most at a loss. But contemporaneously, and in no less degree in my opinion, ought we to take care to provide for that other object, the pleasure, the rational and intellectual pleasure of our members—and one of the conditions precedent required for the attainment of that end is the suppression or removal from our midst of all unworthy jealousies, all factious disagreements, all strivings for the mastery. It is for this reason that we taboo all references to religious or political subjects, and we can at least take this credit to ourselves, that it is but very rarely that anyone violates this prohibition. I claim, then, that such a Society as ours should not be conducted on such rigid and stern financial lines as would be necessary if it were a purely business concern; we should not indeed run into debt, but with that exception we should cultivate such a spirit of tolerance and mutual forbearance with one another's weaknesses and hobbies as will enable us to live together, a peaceable and happy family.

It is now my intention to ask you to listen for a short time to some account of the progress in recent years of the

latest born of the sciences—I mean that which bears the somewhat cumbrous title of Bacteriology. Our attention will be confined mainly to certain questions of their physiology and modes of occurrence, upon which now our knowledge is more exact than it was some years ago.

Bacteria (more properly called Schizomycetes) are minute cells devoid of nuclei, which are able to derive their nitrogen from ammonia compounds, and are therefore not animal but vegetable cells. They are also devoid of chlorophyll, and therefore belong to the group called Fungi. A great part of their substance consists of water, even as much as eighty-three per cent. Of the dried constituents we find—

A nitrogenous substance	84·20
Fatty matter	6·04
Ash (mineral)...	4·72
Undetermined	5·04
	100·00

The only one of these which calls for particular description is the nitrogenous substance, which is analogous to the protein of other members of the vegetable kingdom, and is therefore called Mycoprotein. It forms the essential constituent of the protoplasm; it varies slightly in different species, but so far as is known at present contains no sulphur or phosphorus. The cell-wall usually consists of cellulose, but according to Nencki the cell-wall of the putrefactive Bacteria consists of a mixture of cellulose and mycoprotein. It is certain at any rate that the wall of the latter is acted upon by various staining agents which also act similarly upon the cell-contents, while in the case of the other Bacteria the cell-wall and the cell-contents are differently affected. Vincenzi states that the cell-walls of *Bacillus subtilis* contain *no* cellulose, and thus they approach the character of the cells of animals.

The cell-contents are protoplasm (chiefly consisting of mycoprotein) and various inorganic substances in minute proportions, such as the salts of potash, lime, soda, magnesia, or iron. A few species contain starch granules, and are coloured blue by iodine; others contain pure sulphur in the form of non-crystalline granules. The colouring matter of most coloured Bacteria is external to the cell, being of the nature of an excretion; but in a group, of which *Beggiatoa (Clathrocystis) roseo-persicina* is the type, it exists dissolved in the protoplasm, and is of a peculiar nature. The ordinary pigments of Bacteria can only be developed by the aid of free

oxygen; that is, the microbe produces a chromogenous substance which is oxidised into a pigment; some of them can be forced to grow in the absence of oxygen, and in that case the characteristic colour is not produced.

Bacteria require for their growth carbon, oxygen, hydrogen, nitrogen, and minute quantities of various minerals. Many of them require free oxygen; others can obtain it from the oxidised compounds of the medium in which they live; the first kind are called aërobic, the second anaërobic, but the distinction is not an absolute one. The nitrogen can be assimilated either from albuminous substances, or from ammonia and ammonium salts. They can grow in Pasteur's solution, and thus are capable of obtaining their nitrogen from inorganic substances. The carbon they obtain from sugar, glycerine, or from more complex organic bodies. Water is also essential to their growth, but desiccation does not necessarily kill them, although it does the comma-bacillus of Asiatic cholera. One of the reasons why sugar preserves from putrefaction is that it combines greedily with the water of the preserved substance, and thus hinders any germs that may be present from developing by depriving them of one of the essentials of their growth. Nine or ten kinds of Bacteria are now known which are phosphorescent, and in fact are the cause of the phosphorescence of putrid fish. Cultivated on a plate, in the manner hereafter described, the little colonies shine in the dark like stars in a midnight sky. They can even be photographed by the light they emit.

It has been shown that direct sunlight is fatal to the putrefactive Bacteria, and even to some of the pathogenic species. But on the other hand several species are known which flourish better in the light than in the dark. Engelmann has investigated these, and gave to the one on which his chief observations were made the name of *Bacterium photometricum*. The Beggiatoa previously mentioned, which is common in some stagnant pools, is another species. They all belong to the sulphur Bacteria, which, in the presence of free hydrosulphuric acid, become filled with sulphur granules. Some of these sulphur Bacteria are colourless, but others are characterised by a peculiar peach-purple pigment, diffused in the protoplasm, which is called Bacterio-purpurin, and is capable of acting somewhat in the same way as chlorophyll. When they are exposed to light there is found to be an evident proportion between the amount of light absorbed, and the physiological effect produced. In the absence of light they ultimately perish. The peculiar effect of light upon them is due to its direct

absorption, and does not depend upon the presence of sulphur, but upon the presence of Bacterio-purpurin. By its aid, in fact, they give off oxygen, and oxidise the sulphur to sulphuric acid. The elimination of oxygen is found to be proportionate, for different wave-lengths, to the absorbed energy of the light. Bacterio-purpurin, therefore, is a true chromophyll, and is capable of acting, like the colouring matter of Diatoms and the red Sea-weeds, in somewhat the same way as chlorophyll. But it is known that in the latter two chlorophyll is present, though masked by the other colouring matters. In Bacterio-purpurin, however, chlorophyll is entirely wanting. These experiments produce unexpected results, and may require confirmation; but that they must not lightly be rejected is enforced by two other facts equally contrary to our usual hard and fast rules, viz., that three organisms which exactly resemble Bacteria, and which even De Bary includes among them, are coloured by real chlorophyll, and that several others (which, strange to say, do not contain chlorophyll) are capable of producing in their protoplasm a substance which is usually called starch, and which if not starch, or the "granulose" constituent thereof, is, at any rate, very closely similar to it.

But most Bacteria act like Fungi, requiring oxygen, and therefore would be able with advantage to live in symbiosis with Algæ. The only instance yet recorded of what is believed to be such a connection is that of Glaucothrix with *Bacillus muralis* on the walls of a greenhouse; the connection here, however, was of a looser nature than that symbiosis of Algæ with Fungi, which constitutes the Lichens.

(*To be continued.*)

FORAMINIFERA OF OBAN, SCOTLAND.*

BY E. W. BURGESS.

At the end of 1887 and the beginning of 1888, I was entrusted with the material, No. 49, from 20 fathoms depth, near Dunstaffnage, Oban Dredgings (Birmingham Microscopical Society, 1883), to discover what Foraminifera it might contain.

I have washed the material, made a slide of the different species, containing 67 specimens, which is presented to the Society, and I now add a few remarks upon the several specimens, with references to the following papers upon the subject.

* Transactions of the Birmingham Natural History and Microscopical Society, read 6th June, 1888.

To avoid lengthy repetitions, only the name of the author and date are repeated.

Williamson, C. W., Recent Foraminifera, Gt. Britain (Ray Soc.), 1858.

Robertson, D., Fauna, West of Scotland, Trans. Geo. Soc., Glasgow, p. 51, 1874.

Robertson, D., Proc. Nat. Hist. Soc., Glasgow, 1881-3.

Wright, J., Proc. Belfast Nat. Field Club, 1880, etc.

Balkwill, F. P., and Millett, F. W., Foraminifera of Galway, Jour. Mic. and Nat. Science, 1884.

Balkwill, F. P., and Wright, J., Foraminifera, Coast of Dublin and Irish seas, Trans. Roy. Irish Acad. (Science), 1885.

These interesting subjects for microscopical examination are found in all parts of the world, both at the bottom and also on the top of the seas (pelagic); also forming a great portion of many of the geological strata of the world.

From the lime contained in the sea-water they construct a test, or shell, of extreme beauty in most cases; in others they collect the lime into such peculiar forms that they might often be mistaken for minute water-worn bits of stone (Nubecularia, etc.); or cement, either minute or coarse grains of sand, or smaller shells of foraminifera together, to form a dwelling for themselves, which, in a living state, is surrounded by a jelly-like mass; and they throw off through it and the test pseudopodia or threads of their bodies, crossing threads, in search of food, from which the name Reticularian Rhizopoda is given to them in their classification in the animal kingdom.

Perhaps of all persons who have given their minds to the study of the living forms in this country, Mr. J. D. Siddall deserves the greatest thanks, for the life-history of the Shepheardella tæniformis, Quart. Jour. Mic. Science, 1880. Many others, not having the opportunity of keeping them alive, have resorted to the study and classification of the dead shells.

The bottom of the sea, at the place where the dredging was made, consists of dead and broken shells, Entomostraca, sand, and mud.

I have added Mr. D. Robertson's remarks, if recorded, such as common, abundant, rare, etc.

I have also to record my thanks to Messrs. J. Wright and H. B. Brady for their kind assistance.

Description of the Specimens.

1. *Biloculina ringens.* Lamarck, 1804.
   Williamson (R. F.), 1858, p. 79, pl. vi., figs. 169-70-71.
   Balkwill and Wright (J. F.), 1885, pl. 12, figs. 6-7.
   Robertson. D. (W. S.), 1874, common.
   Prof. Williamson's figures give a good guide to the knowledge of this species, and as Mr. J. Wright remarks the *B. elongata* is merely an elongated form of *B. ringens*, and as the two forms pass into each other they can only be considered as varieties of one form. Common.
2. *Biloculina depressa.* D'Orbigny, 1826.
   Williamson (R. F.), 1858, p. 79, pl. vii., figs. 172-4.
   Balkwill and Millett (Galway), 1884, p. 5.
   Robertson, D. (W. S.), 1874, common.
   An oval, flattish form, with sometimes a broad carinate edging on each side. Common.
3. *Spiroculina limbata.* D'Orbigny, 1826.
   Williamson (R. F.), 1858, p. 82, pl. vii., fig. 177.
   Robertson, D. (W. S.), 1874, common.
   Oban, 1883. Very rare.
4. *Miliolina trigonula.* Lamarck, 1804.
   Williamson (R. F.), 1885, p. 84, pl. vii., figs. 180-2.
   Robertson, D. (W. S.), 1874, common.
   Oban, 1883. Not common.
5. *Miliolina oblonga.* Montagu, 1803.
   Williamson (R. F.), 1858, p. 84, pl. vii., figs. 186-7.
   Robertson, D. (W. S.), 1874, frequent.
   An elongated form, allied to *M. seminulum.* Rare.
6. *Miliolina seminulum.* Linné, 1767.
   Williamson (R. F.), 1858, p. 85, pl. vii., figs. 183-5.
   Robertson, D. (W. S.), 1874, common.
   Oban, 1883. Frequent.
7. *Miliolina subrotunda.* Montagu, 1803.
   Balkwill and Wright (J. F.), 1885, p. 324, pl. xii., figs. 8-9.
   Balkwill and Millett (G.), 1884, p. 6.
   Robertson, D. (W. S.), 1874, common.
   Often very circular in outline. Common.
8. *Miliolina secans.* D'Orbigny, 1826.
   Williamson (R. F.), 1858, p. 86, pl. vii., figs. 188-9.
   Balkwill and Millett (G.), 1884, p. 6.
   Robertson, D. (W. S.), 1874, frequent.
   A peculiar, large flattened form. It is proposed by M. Schlumberger to place it with others under the generic name Sigmoilina (*Sigmoilina secans*, D'Orbigny). Rare.

9. *Miliolina ferussacii.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 88, pl. vii., fig. 196.
Balkwill and Wright (J. F.), 1885, p. 325, pl. xii., figs. 10-12.
Robertson, D. (W. S.), 1874, rare.
This form seems to have many peculiarities, but always the outer edge very flat. Very rare.

10. *Miliolina tenuis.* Czjzek, 1847.
Balkwill and Wright (J. F.), 1885, p. 324, pl. xii., figs. 3-5.
Siddall, J. D., Foraminifera, River Dee, Proc. Chester Soc. Nat. Science, Part II., 1878, p. 6.
Robertson, D., Portree Bay, 1880, abundant.
Brady, H. B. (Syn. Brit. For.), Roy. Mic. Soc., 1887, p. 822.
Schlumberger. *Sigmoilina tenuis*, Czjzek.
J. D. Siddall remarks: "An extreme enfeeblement of *M. seminulum*," etc.
H. B. Brady: "There may be some doubt whether such forms are better placed amongst *Miliolinæ* or *Spiroloculinæ*." Rather rare.

11. *Miliolina bicornis.* Walker and Jacob, 1798.
Williamson (R. F.), 1858, p. 87, pl. vii., figs. 190-2.
Robertson, D. (W. S.), 1874, common.
Oban, 1883. Rare.

12. *Planispira celator.* Costa, 1855.
Wright, J., Fauna, S.W. Coast, Ireland, 1886, Proc. Roy. Irish Acad., ser. 2, vol. iv., p. 608.
Robertson, D., Portree Bay, 1880.
Often liable to be mistaken for *Miliolina agglutinans*. The test is oval, with pointed ends produced in opposite directions, sides convex, and the edge thin. Rare.

13. *Cornuspira involvens.* Reuss, 1849.
Balkwill and Wright (J. F.), 1885, p. 327, pl. xii., figs. 2A, 2B.
Balkwill and Millett (G.), 1884, p. 5, pl. i., fig. 1.
A long, whitish tube, coiled in a disc-like form on its smaller end, producing a concave surface, quite distinct from its congener, *C. foliacea.* Rare.

14. *Psammosphæra fusca.* Schulze, 1874.
Brady, H. B., 1879, Quart. Jour. Mic. Science. Vol. xix., N.S., p. 27, pl. iv., figs. 1-2.
Balkwill and Wright (J. F.), 1885, p. 327.
Robertson, D., Portree Bay.

An arenaceous form, composed generally of rather large grains of sand, cemented together into a spherical mass. Very rare.

15. *Reophax scorpiurus*. Montfort, 1808.
 Brady, H. B., 1864. Trans. Linn. Soc., London. Vol. xxiv., p. 467, pl. xlviii., fig. 5.
 Balkwill and Wright (J. F.), p. 328, pl. xiii., figs. 5A 5B.
 Robertson, D. (W. S.), 1874, common.
 Mr. Brady remarks (Rep. Chall.): "The general contour and minuter characters of the test of *R. scorpiurus* depend in great measure upon the locality in which it is found." Not common.

16. *Reophax fusiformis*. Williamson, 1858.
 Williamson (R. F.), 1858, p. 1, pl. i, fig. 1.
 Considered by many persons to be a starved, shallow-water variety of *R. scorpiurus*. Not common.

17. *Reophax nodulosa*. Brady, 1879.
 Brady, H. B., 1879, Quart. Jour. Mic. Science, Vol. xix., N.S., p. 52, pl. iv., figs. 7-8.
 Robertson, D., Portree Bay, 1880; also Frith of Clyde, very rare.

18. *Haplophragmium pseudospirale*. Williamson, 1858.
 Williamson (R. F.), 1858, p. 2, pl. i., figs. 2-3.
 Balkwill and Wright (J. F.), 1885, p. 330, pl. xiii., figs. 6-8.
 Common on the West Coast of Scotland, 30 to 60 fathoms. The specimens from Oban, 1888, are very fine. Very common.

19. *Haplophragmium canariense*. D'Orbigny, 1839.
 Williamson (R. F.), 1858, p. 34, pl. iii., figs. 72-3.
 Robertson, D. (W. S.), common.
 A nauticuloid form, each coil consisting of 6 to 9 segments, the outer coil often enclosing the earlier ones, generally of a bright orange brown colour.
 Common to muddy bottoms. Very rare.

20. *Textularia sagittula*. Defrance, 1824.
 Williamson (R. F.), 1858, p. 75, pl. vi., figs. 158-9.
 Balkwill and Wright (J. F.), 1885, p. 332, pl. xiii., figs. 15-7.
 Robertson, D. (W. S.), 1874, common.
 Allied to *T. gramen*, d'Orbigny, but having its sides more parallel, margins more acute, and in form longer; opaque; not distinctly arenaceous. Not common.

(To be continued.)

IN SHERWOOD FOREST.

BY OLIVER V. APLIN,

MEMBER OF THE BRITISH ORNITHOLOGISTS' UNION.

(Concluded from page 58.)

A far more interesting game-bird is still found in the district. Some three or four miles south-east of Mansfield lies a wide tract of undulating ground, partly heather-clad, partly gorse and bracken-covered, with extensive young plantations of larch, spruce, and fir; and, here and there, topping the higher slopes, patches of oak-scrub, spruce, Scotch fir, &c.; this is Mansfield Forest. The air is fresh and strong, tainted sometimes in spring by the pleasant scent of a newly-burnt patch of heather. Poor and sandy as the soil is in most places, it supports a few sheep, the forest mutton having a well-deserved local reputation, and plenty of rabbits. Here the old race of forest Blackgame still lingers, not yet re-invigorated by any infusion of fresh blood, though it is feared that this expedient must be resorted to if the breed is to be kept up. It is a fortunate individual indeed who chances to see half-a-dozen old Blackcocks feeding out on the sandy fields at the edge of the forest, as has more than once happened to my host in that neighbourhood. I have myself on several occasions been lucky enough to come across Greyhens, springing one once not five yards from my feet; and, on a fine evening in May, a single Blackcock was pointed out to me at the edge of a field of young barley, the sun glinting on his shining breast.

The Whinchat is common on the banks and slopes, but the Stonechat is strangely scarce, while the white upper tail-coverts of the Wheatear occasionally catch the eye as the birds flit on in front. Ascending a purple slope of heather one August day, I saw a Ring Ouzel perched on a sprig of whin, which, on our near approach, flew on and dropped in the heather. Although scarce here, this wild thrush, most at home on the mountain and the fell, has been known to breed about that spot, and the red berries of the rowan trees are so tempting as to overcome his shyness, and draw him down to the wood edges and even into ornamental grounds.

Scattered over the forest, in the hollows, are some lone ponds, bordered with rushes and merging in places into boggy

ground. A long and nearly circular chain of ponds, not far from Harlow Wood, interspersed with patches of bog, clothed with bilberry, wax-heath, and waving cotton grass, and in places with alder and sallow bushes, and partly joined by a rapid trout stream rising in Thieve's Wood, runs through the cultivated fields. Here, besides the common Wild Duck and the Teal, the Shoveller and the Tufted Duck breed in some numbers; the little Grebe also, and the Moorhen and Coot, while the Snipe nests annually in the bogs. A couple of downy young of the latter, taken here by a farm boy, are now, through my friend's kindness, in my collection, and I have a vivid recollection of unsuccessful searches after the nest of a pair on two bright spring evenings. On each occasion the hen bird managed to slip off unobserved, while we were stepping carefully about on the treacherous ground. Once safely off the nest, she remained circling round overhead in the clear sky, uttering a very curious note, *cuck*, *cuck*, *cuck*, and entirely distinct from the *whituk*, *whituk*, uttered on the ground.

In the course of a walk round the ponds in spring I have counted as many as eleven pairs of Shovellers, and this without visiting the outlying forest pools. There can hardly be a more pleasing sight for the ornithologist than a pair of these beautiful ducks quietly floating on the water under the bank of some alder-bordered pond; the many and varied colours of the drake being seen to equal advantage whether bathed in the brilliant morning sunshine, or slightly reflected in the smooth surface of the water under a quiet, grey, evening sky. Presently they rise upon the wing, their monosyllabic flight-cry sounding like *tuck*, *tuck*, *tuck*; once or twice they wheel round us overhead, then sink gently down to alight on the further end of the pond. It is only recently that the nest of the Shoveller has been found in this neighbourhood, for the duck strays away when about to go to nest, laying her eggs generally in mowing grass in the water meadows, and does not bring her young down to the water until nearly full grown. No better or pleasanter spot could be chosen for the observation of the breeding habits of the Tufted Duck than the garden of the old forest "lodge" at Rainworth, where the owner has enjoyed unexampled opportunities of studying the natural history of these neat little black and white ducks. Here, seated under the beech trees down by the water-side, an early summer morning may most enjoyably be whiled away in watching the pair or two which frequent this water. Some time, of course, in each day is spent in actively diving for food, the ducks generally remaining under water some fifteen or

twenty seconds. In winter, Indian corn is supplied to the birds on the lake, and is eagerly shared by the tufties. Walking along the bank at the upper end of the water one morning, we witnessed a curious incident. A pair of Tufted Ducks, which were feeding, came up with a splash close to us, the duck with something hanging out of her bill, which we soon saw was a river lamprey, some four inches long. Twice did *Fuligula* succeed, with difficulty, in entombing this lively mouthful, and twice did the latter wriggle up into the outer world again, and dangle wildly in the air; the third attempt, however, was more successful, and the duck managed to keep down her slippery meal. No one who has ever had a lamprey fix on his hand with its powerful sucker can help wondering what that duck's sensations were! Lampreys are plentiful in this water. In spring they ascend the clear, rapid, trout stream to deposit their spawn on the gravel, and clusters of them can be seen at that season clinging on to some suitable pebble sufficiently large to maintain a firm position in the bed of the stream. Later on they drop back into the pond, and apparently pass the rest of the year in the sand at the bottom.

But to return to the Tufted Ducks. After feeding, a period of repose is indulged in, when with necks lowered and heads resting on their shoulders, they float placidly on the water, the snow-white flanks of the male contrasting sharply with the glossy blue-black of his upper parts. The drake in spring has a curious habit of elevating his bill and uttering a succession of rather musical notes—a kind of love song. During the few days I had a pair under pretty close observation one year, the duck went on to her nest between ten and eleven in the forenoon. At Rainworth the nest is usually placed on the island, under the shelter of the rhododendrons, and is formed of dead leaves of this shrub and of grass, with a warm lining of down added as the eggs are laid. These vary in number from eight to thirteen, and the clutch is seldom complete before the beginning of June, and often not until the middle of that month; for although the Tufted Duck pairs in March, it does not go to nest until considerably later. The young, when hatched, are taken out upon the water by their parent; the former are proficient in diving and do not seek the shelter of the rushes when alarmed, as is the case with the common Wild Duck. The larger the pond the wilder the ducks, says my mentor, and certainly it is not very easy to approach even the paired birds in spring upon one of the more extensive sheets of water. But as five or six pairs may sometimes be seen there close together, it is worth while to stalk them. With Tufted Ducks at this season the female

takes precedence, swimming always a few feet in advance of her devoted partner. Presently they take the alarm; *curr-ug curr-ug*, now they are up and off, the duck invariably (again I quote my host, albeit having had ample opportunity of testing the truth of the observation) rising first, hurrying along near the surface of the water, with rapidly beating wings, before rising higher in the air, and finishing the flight upon motionless, much-bent pinions, as, with a little twist or two from side to side, they slant downwards to pitch with a splash on the water.

Black-headed Gulls, stragglers probably from one of the "gulleries" in the neighbouring county of Lincoln, are sometimes attracted by this marshy, pool-studded belt of country. Even in early June I have seen this species, wearing the distinctive brownish-black hood peculiar to the breeding season, fly over quite low down, and evidently only deterred from alighting by our unwelcome presence.

Many uncommon birds visit the ponds. One day towards the end of April, a pair of Black Terns had tarried here for a few hours, and were busily skimming over the water with the Swallows, which, in company with the delicate little Sand Martins, love to hawk for flies over the ponds in cold spring weather; among them, on one occasion, was a Swallow with a white tail. When walking round the ponds early in August, we flushed a male Wigeon in the rufous summer plumage, which had probably remained there all summer. Thinking over the Tufted Ducks calls up recollections of fine bright evenings at Rainworth in early summer, when, as we stand on the bank of the pool, the glow of sunset throws into relief every branch and leaf in the plantation opposite. Against the brilliant sky a "drumming" Snipe is clearly silhouetted, and we can distinguish the Guinea fowls roosting in the Scotch firs on the other side of the pond, across which they regularly fly at dusk. The Thrush, the Cuckoo, the babbling Sedge-bird, and the Grasshopper Warbler's incessant reel mingle with the mellow call of the Peewit on the upland fallows and the drumming of the Snipe. Swallows, belated, and bats flit over the water, broken by the splash of the trout throwing themselves sportively out of the water, or leaping at the infrequent fly. Perhaps you may be lucky enough to see a Nightjar skimming on noiseless wings over the pond, in pursuit of the moth and chafer, and you may often catch the whistling sound of ducks' wings as they fly overhead. The vocal chorus is continued far into the still, warm nights, and at midnight the "reel" of the Grasshopper Warbler, rising and falling, came in waves of sound; the Sedge Warbler chattered

on, Coots clanked, now and then the "chuckle" of a Moorhen or the subdued quack of a Wild Duck was heard, and the distant call of the Peewits smote softly on the ear.

One summer four pairs of Grasshopper Warblers were nesting round the house, and I once had an interesting interview with this shy species at closer quarters than it has been my luck to be on any other occasion. While the male of a pair, which haunted a little osier bed, was singing loudly one evening. I managed to creep close up to it, along the boundary hedge, and, after severel cursory sights of it as it flitted about among the osiers or crept in a mouse-like way up the slender wands, I at length marked it in the hedge. Pushing my face cautiously in among the leafy twigs, I found myself within eighteen inches of the bird, which showed up clearly against the light as it sat in a rather upright position singing loudly. During the delivery of the "trill" the bill is open to its widest extent, and the mandibles are motionless. The head meanwhile is slowly turned from side to side, and this, and the varied pitch at which the song is delivered, produces the ventriloquism often spoken of.

Truly this is a land of oaks, and many are the venerable specimens celebrated in local tradition. On this side of the forest the most noted is, perhaps, that under which King John held a Parliament; but a finer sight by far is presented by the famous trees locally known as the "Hayward Oaks," which are scattered over the paddocks around a farmstead near Blidworth. Some two hundred in number, they are said to date back to the time of the Conquest, and though long past their prime, the spreading branches of many of them still cover wide spaces, and they are annually clothed with fresh rich green; some of them of enormous girth, in their gnarled and rugged beauty this collection of ancient oaks can, perhaps, hardly be matched anywhere in England. Many Stock Doves breed in the hollows of the oaks, and here a very curious hybrid, between one of these birds and a dovecot pigeon from the farmstead, was reared a year or two ago. It had been seen frequenting the oaks for some little time, and was at last with difficulty secured, as it was very wild. A coloured figure of this bird is given in Mr. Mosley's work on "British Birds."

Tradition assigns to the neighbourhood of Rainworth the scene of some of Robin Hood's exploits. The Cave Pond, a favourite resort of Shovellers, &c., is locally believed to have been the one across which Friar Tuck was compelled to carry that worthy on his shoulders; and "Bishop's Hill," where the prelate danced with assumed and unfelt gaiety, is close at hand.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 68.*)

We must now return to Mr. Edwin Lees and his further contributions to the Botany of the County.

In the year 1842 he published the first edition of the "Botanical Looker-out among the Wild Flowers of the Fields, Woods, and Mountains of England and Wales." A second edition appeared in 1851. In this work the author notes the most striking species which appear in flower in the successive months of the year, in various parts of England and Wales. It may be inferred from pages 94 and 95 of the first edition (pp. 138, 139 of the second) that the following trees, not previously recorded, occur in Worcestershire:—

Lime. Tilia intermedia.

Blackthorn. Prunus spinosa.

Alder. Alnus glutinosa.

Beech. Fagus sylvatica.

Hazel. Corylus Avellana.

The next work of the same author is the well-known "Botany of the Malvern Hills." Of this there are three editions, none of which bear a date on the title page. The prefaces are dated respectively May 12th, 1843; August, 1852; July 31st. 1868.

This work is of some importance in the history of Worcestershire Botany. It is the first in which all the plants are recorded, and the first also in which any attempt is made to discriminate the Rubi. Mr. Lees enumerates, in the first edition, 786 species of flowering plants and ferns as growing in the Malvern District. Those from adjoining parts of Hereford and Gloucester are admitted, and there is some difficulty in distinguishing them. Very few localities are mentioned in the first edition; these I have added where necessary from the second and third. I have omitted many of the commoner species which have been previously noted. The author explains that "where the capital E is placed after a plant it signifies that it is confined to the eastern side of the hills; W to the western side; H denotes that it is limited to the hills themselves or to their protruding rocks."

EDWIN LEES, IN THE "BOTANY OF THE MALVERN HILLS," 1ST EDITION, 1843.

Plants also recorded in Mr. Lees' Catalogue in Hastings' "Illustrations of the Natural History of Worcestershire" are distinguished by the letters Ill.

* **Clematis Vitalba**, p. 28. Ill.

* **Thalictrum flavum**, 28. Longdon Marsh. Ill.

* **Myosurus minimus**, 21. E. Rare.

Ranunculus aquatilis, β. pantothrix, 28. In little pools on Welland Common.

R. circinatus is intended here. See 3rd Edition, p. 77.

* **R. fluitans**, 28. With stems many feet in length. Occurs in the Teme at Powick.

R. sceleratus, 28.

R. Flammula, 28.

R. auricomus, 28.

R. acris, 28.

R. bulbosus, 28.

R. hirsutus, 28. (2nd Edition, 60. I have only gathered R. hirsutus in a barren pasture bordering on Longdon Marsh.)

* **R. parviflorus**, 28. (2nd Edition, 60. Not very uncommon on dry banks, as about Barnard's Green and Powick.) Ill.

R. arvensis, 28.

* **R. Ficaria**, 28.

Caltha palustris, 29.

* **Helleborus fœtidus**, 29. This I have received, as growing at Cotheridge, from John Walcot, Esq., of Worcester.

* **Aquilegia vulgaris**, 28. Borders of woods, westwards, both with purple and white flowers. Ill.

* **Delphinium Consolida** (*D. Ajacis*), 28. Rare. E. Ill.

* **Papaver Rhœas**, 28.

* **P. dubium**, 28.

P. Argemone, 28.

* **Corydalis claviculata**, 34. On the declivities of the North Hill. Ill.

* **Fumaria capreolata**, 34. Ill.

F. officinalis, 34.

Brassica campestris, 33.

B. Rapa, 33.

* **B. Napus**, 33.

Sisymbrium officinale, 33.

Erysimum (*Sisymbrium*) **Alliaria**, 33.

* **Cheiranthus Cheiri**, 33. Little Malvern Priory, but scarcely wild.

* **Cardamine impatiens**, 32. This is quite a common plant all about the eastern bases of the hills.

C. sylvatica, 32. Ill.

Arabis thaliana, 33.

Barbarea vulgaris, 33.

Draba verna, 32.

* **Königa maritima** *(Alyssum maritimum)*, 32. In the lane near the Chalybeate Spa, in 1841. Ill.

Capsella Bursa-pastoris, 32.

Lepidium campestre, 32.

* **L. Smithii**, 32.

* **Senebiera Coronopus**, 32.

*† **Reseda lutea**, 23. Found by W. Addison, Esq., but it must be very rare, for I have failed ever to observe it myself.

I suspect an error. It is not acknowledged as a Malvern plant in Lees' "Botany of Worcestershire."

‡ **R. fruticulosa**, 23. I have gathered this at Worcester. *Not native.*

* **Cistus Helianthemum** (*H. Chamæcistus*), 28.

*† **Viola canina**. 18. *Viola sylvatica, Fries, is doubtless intended here. See Scott's list, "Midland Naturalist," Vol. XI., January, 1888, p. 17.*

V. flavicornis, 18. *This must be V. flavicornis, Forster, a variety of the last.*

* **V. arvensis**, 18. *See Scott's list above referred to.*

* **Polygala vulgaris**, 34. Frequent on the western side of the range, with red flowers. *Doubtless the typical species. See Walker's list, "Midland Naturalist," Vol. XI., April, 1888, p. 121.*

* **Drosera rotundifolia**, 21. In the bog at the western base of the Worcestershire Beacon. Ill.

* **Dianthus Armeria**, 22. In pastures below the Abbey Church, but rare. Ill.

* **Saponaria officinalis**, 22. Between Worcester and Cotheridge, not far from Mudwall Mill. Banks of Severn. Ill.

Lychnis dioica, 23. Red and White Campion.

This must be accepted as a record for both the following segregates:—

L. diurna.

L. vespertina.

Agrostemma Githago, 23.

* **Moenchia erecta**, 16. In profuse abundance on the hills. Ill.

Cerastium semidecandrum, 23.

C. vulgatum, 23. Broad-leaved Mouse-ear Chickweed. *C. glomeratum, Thuil.*

C. viscosum *(C. triviale, Link)*, 23. See 3rd Edition, p. 60.

* **C.** *(Malachium)* **aquaticum**, 23.

Stellaria holostea, 22.

* **S. glauca**, 22.

S. graminea, 22.

* **Arenaria trinervis**, 22. Ill.

A. serpyllifolia, 22.

* **A. tenuifolia**, 22. Ill. *Mr. Lees gives no locality for this rare species, noted by Stokes, on Ballard's authority, as occurring on the Malvern Hills. It is not acknowledged as a Malvern plant in the 3rd Edition.*

* **A.** (*Spergularia*) **rubra**, 22. Ill.

* **Sagina apetala**, 16.

S. procumbens, 16.

* **Spergula** (*Sagina*) **nodosa**, 23. On the edges of various springs on the sides of the hills, especially of the western descent of the Worcestershire Beacon. Also on Welland Common. Ill.

† **S.** (*Sagina*) **subulata**, 23. *Noted, without locality, as a Malvern plant in all three editions, but not acknowledged as a Worcester plant in the "Botany of Worcestershire." An error?*

* **Montia fontana**, 14. H. Ill.

* **Hypericum Androsæmum**, 36. Not uncommon in deep shady lanes about the Wells and Little Malvern, &c. Purlieu Lane. Ill.

* **H. calycinum**, 36. Little Malvern, but probably introduced. Ill.

* **H. dubium**, 36.

* **H. humifusum**, 36.

* **Malva moschata**, 33. Ill.

* **M. rotundifolia**, 33. Ill.

Tilia grandifolia, 28. In a field near the Priory Farm, Little Malvern.

T. europæa (*intermedia*), 28. In a natural wood at the N.E. base of the Warren Hill.

* **T. parvifolia**, 28. Undoubtedly wild in woods on the Old Storrage, on the banks of the brook above Bridge's Stone Mill, on Rosebury Rock, Knightwick, &c. Ill.

* **Linum usitatissimum**, 21. Occasional.

* **Geranium phæum**, 33. Near Cradley and Grimley. (2nd and 3rd Editions. By the side of a watery lane beyond Hales End, Cradley; Dr. Addison.)

Cradley is in Herefordshire.

* G. pyrenaicum, 33. (2nd and 3rd Editions. Under the hedge of a meadow by a footpath between Cotheridge and Bransford Roads, St. John's, near Worcester.)

G. molle, 33.

* G. lucidum, 33. Very plentiful on the rocks. Ill.

(To be continued.) / 141

THE SEPARATION OF ROCK CONSTITUENTS BY MEANS OF HEAVY SOLUTIONS.*

BY T. H. WALLER, B.A., B.SC.

In investigating the history and geological relations of the crystalline rocks, the microscopical examination will sometimes show differences between masses closely similar in their average chemical composition—varying groupings of the elements being brought about in all probability by differences in the conditions of crystallisation and solidification. To take a simple example, the average composition of the ordinary Hebridean gneiss of the North-west of Scotland—what is generally termed the bulk analysis—agrees almost exactly with that of a normal andesite; such, for instance, as that from Montserrat, which I have shown here on two or three occasions.

In addition, therefore, to making a bulk analysis of a rock, it is frequently desirable to analyse the component minerals, so far as they can be separated.

For the purpose of this separation two lines of procedure have been used. In the one the powdered rock is allowed to stream between the poles of a tolerably powerful electro-magnet, which retains those minerals which contain iron in any notable proportion, allowing the others to pass freely. This requires frequent repetition before the separation is complete, and then leaves the problem of the separation of, say, quartz and felspar untouched. Nevertheless, it is a useful auxiliary to the other method, and an ordinary bar-magnet is serviceable in removing magnetite from other minerals.

The other course is that which I am to show to you this evening, namely, the use of heavy solutions.

* Transactions of the Birmingham Natural History and Microscopical Society, April 17th, 1888.

The solution I shall use is the double iodide of mercury and potassium which is made by dissolving 220 grammes of iodide of potassium in water, and adding to it 290 grammes of the biniodide of mercury. The scarlet iodide gradually dissolves, forming a yellowish liquid which is to be evaporated on the steam bath until it crystallises on cooling. The addition of a drop or two of water redissolves the crystals, and the solution may then by readily filtered through paper. It has a specific gravity of 3·196; that is to say, fluor spar floats on it.

By substituting the iodide of barium for the potassium salt, the specific gravity may be increased to over 3·5. In this case the proportions are 100 of iodide of barium to 130 of the iodide of mercury. The two salts are heated and shaken with 20 of water until they are dissolved, and then concentrated, if necessary, until topaz floats. In diluting the solution in the process of separation, an already diluted solution should be used to prevent a partial decomposition and deposit of the iodide of mercury, which is liable to occur when water is used.

Another liquid used for the purpose is the borotungstate of cadmium, which can be obtained with the specific gravity of 3·6. Its preparation, however, is very troublesome, and in using it all carbonates must be previously removed as they decompose the substance.

Biniodide of methylene has also been proposed as likely to be useful. It must be diluted with benzol, which may be evaporated off to obtain the substance ready for use again.

The next point to be considered is the preparation of the specimen of the rock.

This should be broken up in a mortar (a brass or bronze one of the tall shape is the best), and care must be taken to make as little actual fine powder as possible. By means of sieves the powder is separated and examined under the microscope, and the fraction must be chosen which is the largest grained; one which is homogeneous. This will generally be such as will pass through a sieve of forty or fifty meshes to the inch. The very fine powder must be sifted out, say, through a 100 mesh sieve.

Small beakers are taken, which should have a lip and hold about 1½ to 2oz.

Take about 30 c.c. of the solution and stir in the rock powder and a fragment of larger size of a mineral of known specific gravity to act as an "indicator." On settling, it will

probably be found that a separation has occurred; some of the constituents have fallen to the bottom of the beaker, the rest float. In the former fraction we have the ores, such as magnetite, ilmenite, pyrites, augite, and olivine. The floating portion consists of the felspars, quartz, with some of the subordinate minerals. This lighter fraction may be partially skimmed off with a glass or platinum spoon, and then the liquid is poured off the heavy part, which may be done pretty completely, usually leaving a ring of the lighter particles adhering to the sides of the beaker, interrupted, however, at the spout by a gap where the liquid was poured out. Through this gap, which should be made as wide as possible by gentle swaying from side to side while pouring, the heavy portion is washed into a porcelain dish by means of a wash-bottle. It is washed by decantation and boiling with water and a little solution of iodide of potassium, and then dried.

The addition of water, drop by drop, to the liquid on which the lighter part of the rock is floating, soon effects a separation, and, if this is continued till another "indicator" just sinks, we know to what specific gravity we have reduced it. In order to get the substances quite pure a repetition of the process is required. This may be suitably performed in a tube closed below by a stopcock, through which the heavier fraction may be run off.

To determine the specific gravity of a mineral, a fragment is floated on the solution and water added, drop by drop, with careful and thorough stirring, until the fragment rests indifferently anywhere in the liquid. Then fill a small specific gravity bottle or tube, and determine the specific gravity by weighing. A more simple plan, and one which is quite accurate enough for almost any purpose, is to use the principle of Westphal's balance, and weigh a plummet, of which the weight in air and the specific gravity (which must be greater than that of the liquid) are known, immersed in the liquid. The plummet for this purpose may be made of a glass tube containing mercury, and its specific gravity is, of course, previously determined by weighing in air and in water.

The determinations should be repeated, and it is obvious that, when the mineral fragment tends neither to sink nor rise in the solution, the specific gravity of the two is idêntical.

For the suggestion of the potassium iodide fluid we are indebted to Sonstadt, for that containing barium iodide to Rohrbach, and for the borotungstate of cadmium to Klein.

The solutions may also be of what is ordinarily termed practical use. For instance, we occasionally pick up on the seashore pebbles which have the colour and apparent lustre of topaz. The readiest means of determining whether it is this mineral or merely a coloured quartz pebble, is the test of specific gravity. Topaz sinks in the mercury potassium solution, while the quartz floats.

Wayside Notes.

Balea perversa (Linn.) in Nottinghamshire.—Mr. G. W. Mellors has sent me specimens of this species from Staunton, near Newark, and from Kirkby in this county. This species has not hitherto been recorded for Nottinghamshire, although records have been made by the Conchological Society's referees for the adjoining counties of Lincoln, Leicester, Rutland, and Derby. From Kirkby the same gentleman has also sent me specimens of *Pupa ringens*, Jeff., the only locality, he states, around Nottingham where he has been able to find this species.—Joseph W. Williams, Mitton, Stourport, Worcestershire.

Death of Prof. S. O. Lindberg.—I regret to have to announce the death of the late eminent bryologist, Prof. Sextus Otto Lindberg, M.D., F.D., of Helsinfors University, who passed to his rest February 20th, 1889. This eminent botanist was born at Stockholm, March 29th, 1835, and by his own exertions raised himself from a comparatively obscure position to hold a high post at Helsinfors University, to be the most eminent European authority on mosses and hepatics, and to have the respect and admiration of botanists throughout the world. As a field botanist he was remarkable for his wonderful powers of observation; I believe I am right in saying that he rarely if ever used a lens, but could, with the unassisted eye, make out the most minute details of his plants. To the literature of botany his contributions were of unexceptional value; space, however, will not allow of more than a passing glance at his work in this direction. At various times he contributed articles on Bryology to the "Journal of the Linnæan Society" and the "Journal of Botany." But his most valuable papers were communicated to the scientific journals of his own land, all of them abounding in original thought and evidences of original research. Among the more noteworthy are "Torfmossornas byggnad Utbredning och Systematiska Uppställning," a valuable paper on the Sphagnaceæ; "Kritish Granskning af Mossorna uti Dillenii Historia Muscorum," most valuable as giving the modern synonomy of Dillenius' great work; "Musci Scandinavici in Systemate Novo Naturali Depositi," a full moss and hepatic flora of Scandinavia, with descriptions of many new species. "Monographia Metzgeriæ," "Observationes de formis præsertim europæis Polytrichoidearum," "Om de europeiska Trichostomeæ," "Sandea et Myriorrhynchus Nova Hepaticarum Genera," "Monographia præcursoria, Peltolepidis, Sauteriæ et Clevesæ," &c., &c. Throughout all these papers we have evidences of many years' close study in the exhaustive

synonymes of each species enumerated. Although many may differ with the learned doctor's nomenclature, all who knew him, either personally or by correspondence, will deeply regret his death.—J. E. BAGNALL.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, Feb. 19. Mr. T. H. Waller, B.A., B.Sc., chairman. Exhibits by Mr. Edmonds, a slab of red sandstone showing ripple marks, from the cemetery; Mr. W. B. Grove (on behalf of Miss Gingell), a fungus, Judas' Ear, from Dursley, Goucestershire; Mr. W. H. Wilkinson, a starfish with fourteen rays, a sea-mouse (Aphrodite), an octopus washed up at Llandudno after the late storm. A series of photographic views of coal mines was exhibited by Mr. Alfred Pumphrey. Notes on the Volcanoes of the Two Sicilies, by Dr. Tempest Anderson, of York, were read by Mr. W. P. Marshall. The views in both cases were shown on the screen by the aid of the oxy-hydrogen lantern by Mr. Chas. Pumphrey. Mrs. W. B. Grove and Miss Moseley were unanimously elected members of the Society.—ADJOURNED ANNUAL MEETING, Mar. 5. Mr. J. F. Goode in the chair. Mr. W. B. Grove, M.A., delivered his retiring address, which is printed in the present number.—BIOLOGICAL SECTION, Mar. 12. Mr. H. M. J. Underhill, of Oxford, gave a paper on "The Eyes of Insects and the Way they See," illustrating it by a series of photo-micrographs and diagrams as lantern views. These were shown on the screen by Mr. Charles Pumphrey, by the aid of the oxy-hydrogen lantern. There were also shown under microscopes a number of preparations from which the photo-micrographs had been taken. Mr. Underhill having first described the structure of the human eye and the simple eyes of the spiders, gave an account of the wonderful facetted compound eyes of the housefly and insects generally. He then gave the results of experiments he had made with the cornea of the compound eye of Dyticus, a water beetle, in order to test the action of the lenses of the individual cones or facets. He described the idea of the "mosaic" character of the image formed by these compound eyes, the image of each eye forming a single portion of the whole mosaic, and inferred that this idea was incorrect because the individual eyes would each form a reversed image of the portion of the object seen by it and the combined picture consequently be thrown into confusion. He thought it most probable that insects would not see with the whole number of their eyes at once, but that the brain would only receive the impression of the image formed by those most favourably situated for seeing in the direction to which the attention might at the moment be directed, in a similar way to the manner in which we are able to concentrate attention upon a part of the image presented by our eyes, without really *seeing* everything.—GEOLOGICAL SECTION, Mar. 19. Professor Chas. Lapworth, F.R.S., chairman. Mr. W. E. R. Martin, F.R.M.S, was proposed for membership by Mr. Alfred Hill, M.D., seconded by Mr. W. H. Wilkinson. Mr. Edmonds exhibited sandstone from cemetery with dendritic markings, and micaceous sandstone. Mr. T. H. Waller, B.A., B.Sc., read a paper on "The Petrology of the

Pebbles of our District." In the discussion which followed, this paper was characterised by Professor Lapworth as a very valuable addition to our knowledge of the Pebble Beds.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 18th. Mr. H. Hawkes presented to the Society a collection of two dozen microscopic slides of the Myxomycetes; a hearty vote of thanks was accorded the donor for his gift.—Feb. 25th. Mr. J. Rodgers read a paper on "Climate as Affected by the Inclination of the Earth's Axis." The author said the question of climate was so complicated a subject that it would be difficult to deal with it in a single paper. The local circumstances that affected climate were reviewed at some length and many illustrations given. When we compared the Earth with other planets we found a great family likeness, but the inclination of their axes varied considerably, this variation extending from 3° to 75°. The different planets were enumerated and their probable climates commented on. The writer held that the inclination of the Earth's axis was gradually diminishing, and gave ideal pictures of the course of climatic changes during 16,000 years; this period giving the greatest degree of heat and cold. The idea that a uniform winter ever prevailed for a number of years was combated, as it would not account for erratic boulders, and large deposits of river gravels. Several speakers dissented from these views, a discussion closing the meeting.—March 4th. Mr. H. Hawkes exhibited an album of mounted seaweeds; Mr. J. W. Neville, specimens of arenaceous foraminifera; Mr. H. Hawkes, preparation of *Lomentaria kaliformis* and *Codium tomentosum*, both marine algæ. —March 11th. Mr. J. Madison exhibited the following shells:— *Bithynia rubens* and *Neritina neritoides*, from Sicily; also *Melania bolonensis*, from New South Wales. Mr. Hawkes, mounted specimens of *Habenaria bifolia*, *Ruscus aculeatus*, *Botrychium lunaria*, and other plants. Under the microscopes: Mr. J. Moore, gastric teeth of grasshopper; Mr. J. Collins, fruit of *Chara vulgaris*; Mr. Hawkes, leaves of *Drosera rotundifolia*, with captive insects. Mr. Corbet showed a large specimen of brain coral, and fossil specimens of Favosites from Dudley. In the unavoidable absence of Mr. A. T. Evans, Mr. H. Hawkes read a paper on "The Pleasures of an Herbarium." What is the use of an herbarium? is a question often asked by those who see little to admire in the faded mummies of the beautiful flowers they represent. The pleasures of an herbarium are those of association. The yellow-horned poppy called to mind the boiling sea near which it was gathered; the orchis reminded us of the treacherous sphagnum in the marsh where it was secured, and so with all other plants. The writer said this was only considering it from a sentimental point of view, and the question remained, of what use is an herbarium? If we once gathered the plants ourselves, we became acquainted with their habitats, and gained a practical knowledge of botany we could not get by any amount of reading. To make our collection as complete as possible we are led into all sorts of places; to inquire into the introduction of plants and their distribution. It also leads us into many a bye-path of science, and brings us face to face with the world of microscopic fungi, the spiders that spin their webs on plants, and the insects and mites that make their cradles in the leaves. This subject opens up so wide a field that it might profitably employ the leisure hours of a life-time.

ON THE AUTUMN MIGRATION OF SWALLOWS AND MARTINS.*

BY W. WARDE FOWLER.

Ever since I was lucky enough, in September, 1885, to see something of the passage of migrating birds over the Alps of the St. Gothard district, I have kept a careful watch on the movements of birds in that month; and more particularly on the journeying of the Swallows and Martins. These birds are comparatively easy to observe on migration, for they are almost always on the wing, and, even when they settle, usually prefer a conspicuous and airy place, such as a house roof, a church tower, or a tree from which the leaves have already in part fallen. Most other small birds seem to pass from our woods and hedgerows in some quiet and mysterious way, and to find their way to the coast gradually and silently, rarely startling the observer by allowing him to see them in packs, or in such rapid movement as could be recognised at once as *travel*. But the Swallows and Martins, if they are closely watched towards the end of September, may be observed, not only gathering and exercising themselves before their departure, but actually performing their daily journey; and only patience and good opportunities are needed to enable us to discover something of the methods by which these journeys are conducted.

As a classical student, my experience has been, that if I fancy I have discovered something new in that department of learning, I almost always, sooner or later, find to my chagrin, that someone else—usually a German—has been on the ground before me. But no one seems as yet to have given his whole mind to this migration of the Swallow tribe, or at least to have recorded his observations in any easily available book or periodical. I am speaking, be it clearly understood, of England and Englishmen; for we seem to know a good deal more of the course of migrating birds after they have left our island, than of the nature of their travel while they are still within it. We know something from the "Migration Reports" of their passage along the eastern and western coasts of the island; but very little of their movements on the south coast, and almost nothing of the process by which they gather in the interior and find their way to the sea. What little I have noticed myself on the coast of Dorset, and inland in Oxfordshire, I propose to set down in this paper.

* Part of a paper lately read to the Oxford Natural History Society.

On September 20th, 1887, while staying at West Lulworth, half way between Weymouth and Swanage, I discovered that every Swallow and Martin which I saw was steadily travelling eastwards. They travelled in parties of from fifty to two hundred, just as I had seen them in the Alps, and as they are described in the "Migration Reports." I could trace these parties for a long distance with my glass, as I stood on a long and narrow ridge of down some five hundred feet above the sea; their general direction was always due east, though they seemed to follow pretty closely the long line of the down, which curves somewhat inland eastwards from Lulworth. The whole day they continued to pass, not in a continuous stream, but in these great packs, which at one moment were over my head and all around me, and in two or three minutes had almost unawares made half a mile's progress eastwards. They did not, of course, fly straight ahead in a direct course; they seemed to be ever dallying and circling round, sweeping backwards; yet you only had to keep a vigilant eye on them to discover that they were all the time moving onwards, and travelling at a rate which I guessed to be not much less than ten miles an hour.

On that day the wind was easterly, and therefore dead against them; but it was a gentle breeze, and they were able to fly without apparent effort at a considerable height. The next day the wind was stronger; and on the third day, if I recollect right, it was very keen and cold, and instead of soaring they changed their tactics and took to skimming low along the steep flanks of the down. From my post of vantage at the top, I watched with interest the way in which these delicate little birds withstood and conquered the force of a strong head wind. I can see them even now creeping along the shaggy sunburnt sides of that noble breezy down, tacking this way and that, now deep in the grassy hollows, now steering swiftly upwards, now yielding to the gale for a moment in a backward curve, but ever steadily pressing onwards. Some preferred a belt of lower ground between the down and the sea; but I noticed that where this comes to an end and the down itself falls again in precipitous cliffs direct into the waves, they all turned inwards again, hugging the hill, and not venturing to cross even a mile or two of sea to the further arm of the bay in the face of such a wind.

All this was so interesting that I wondered that I had never observed the same thing during previous visits to Lulworth in September. Diaries kept during those visits were at hand, but showed no trace of any such migration. Possibly I had missed the exact days on which the birds

were passing; but it is more likely, I think, that I simply failed to *notice* what was going on. The flight of these birds is so deviating that its *general* direction may very easily be missed, and, in fact, it is almost indispensable that the observer should be posted on some commanding height in order to appreciate it. I have seen the same kind of migration going on in the Midlands since that visit to Lulworth, but found it very difficult to follow and make sure of, owing to the want of such a point of vantage as that noble ridge of down.

Possibly the flatness of our midlands is the reason why so little is known of the actual lines of migration of the Swallow tribe *within this island*, and before they cross the sea. Are there any such regular lines, apart from those along our coasts? Do the birds alter their course according to wind and weather? Do they always travel in parties, and if so, how are those parties formed? Are they the birds of a single district, town, or village? Where do they rest at night —if, that is (as I believe) they do not usually travel by night? At what point, or in what neighbourhood, do they cross the sea to France?

I do not think it would be easy to find an ornithologist who would be prepared to answer any of these questions except at hap-hazard, or who has any precise records of observation on which he could base an answer. These things go on under our very eyes, yet we know nothing about them. I wrote a short letter to "Nature," describing what I had seen at Lulworth, and this letter was copied into the "Field" by Mr. Harting, who edits the Natural History column in that paper; yet to the best of my belief, no one has since then gone further into the matter. I made some little effort to organise a small army of observers for last September, and tried to enlist some ornithological boys at Marlborough; but boys in their holidays are not disposed to lurk about by themselves in the cause of science, and rarely have the patience needed for such work. I had hoped that, coming from all parts of the kingdom to a common centre just at that time, they might have brought with them a good many reports of what the birds were doing in their various neighbourhoods; which, when duly tabulated, might in course of time have produced valuable results. I do not despair, however, of getting something of this kind done, and would suggest the experiment to schools and colleges which meet at that time of year.

Of course I was on the look-out myself again last September, and though I saw little, that little was very

interesting. But before I go on to describe this, I will just state what I consider to be the explanation of the migration I saw in 1887.

I left Dorset that year on September 25th, and spent a few days in Devonshire, partly at Crediton, partly near Bideford. I looked carefully wherever I went for Swallows and Martins, but with the exception of half a dozen lingerers at Bideford, which is warm and sheltered, I saw none; the country was completely deserted by them. I think, therefore, that the great procession I saw at Lulworth must have consisted of the birds of Cornwall, Devon, and perhaps of Somerset (possibly also of South Wales), who were following the coast-line as a guide, and proceeding along it until they should reach a point where it would be convenient to cross the sea. It is a pretty well-known fact that the Pied Wagtails gather in something the same way along the south coast in their autumn migration; and in fact they were on their travels at Lulworth, though in small numbers, at the very same time when I was watching the Swallows. In other years I have sometimes seen them there in such vast numbers that a single field, which was being ploughed, seemed literally alive with them, and after several years' observation, I may hazard a conjecture that the Grey Wagtail takes the same track; for otherwise I cannot account for the regular appearance of these water-loving birds in a district so waterless as that of South Dorset, in the month of September, and in company with their pied cousins.

On returning from Devonshire to my Oxfordshire home, I found that considerable parties of Swallows and Martins were passing over the village at intervals every forenoon. Our own birds, which regularly gather on my house roof for a week or two before they leave, had apparently departed; but from north and west fresh companies continued to arrive, and it was long before we felt that "the Swallows had really gone." These strangers lingered a while about the village, generally in the neighbourhood of the church, and then took their departure in a south-easterly direction along the line of our valley. But, as I have already said, it was difficult to trace their line of flight, and impossible to follow it for any distance, owing to the want of a commanding hill whence I could sweep the whole country with my glass. I may mention that one day at nightfall I found a small orchard in a neighbouring village crowded with them; and, no doubt, this was a detachment, resting for the night, which would proceed on their way early next morning.

In 1888, I was again at Lulworth early in September, but the migration had not yet begun. After leaving it, I spent ten days in Exmoor, where the Swallows were still present in large nnmbers, but gathering for migration. At Withypool, in Exmoor, they had selected a tall tree for a gathering-place, as there was no house in the village with a roof large or sunny enough to suit their needs. It would have been interesting to have followed these birds when they left, and to track them and other companies on their eastward journey; but this I was not able to do, as I had to return to Oxford on the 18th.

But on the 6th of October, just before the Oxford term began, I was able to pay a hurried visit to some friends at Swanage, some fifteen miles east of Lulworth, on the coast of Dorset. I hardly hoped to see anything of migration, as it was so late; but on the morning of the 7th I walked to the rocky coast south-west of the little town. What I saw then, and on the following Tuesday, will be better understood by the reader if he will look for a moment at any map of this part of the coast—unless, that is, he happens to be personally acquainted with it.

From Weymouth, until just before it reaches Swanage, the coast runs in a fairly straight line from west to east, only bulging southwards somewhat about St. Aldhelm's Head; but at Durlstone Point, a mile from Swanage, it suddenly turns sharp to the north for many miles to Poole Harbour, where once more it starts eastwards, past Bournemouth and Lymington, to Southampton Water. Swanage, therefore, looks direct *east* over the sea, and is immediately opposite to the Isle of Wight, the white cliffs near the Needles being a very conspicuous object on any tolerably clear day, though separated from the gazer by some twenty miles of sea.

When, on the morning of October 7th, I reached the coast near Durlstone Point, I found that the Swallow-migration was still going on, for a small party soon passed me and disappeared towards that headland. As they vanished, the question occurred to me, what will they do when they reach the point where the coast turns northwards at a sharp right-angle? Will they follow it northwards, or will they cross the sea to the Isle of Wight, or is this, perhaps, a point at which they strike across to France? It began, in fact, to dawn upon me that this sudden turn in the coast-line was one which would surely raise a question in the minds of the birds as well as in mine, and I was extremely curious to see what they would do.

The question was soon answered. Walking nearer to Durlstone Point I watched for another party, which was not long in coming. They passed by me, and, as they neared the headland, rose in the air, higher and higher, not seeming to move onwards for a while, but simply circling round and rising, and then, at a great height, they set off over the sea in the direction of the Isle of Wight. I followed them with the glass till they were such tiny specks that it was painful to try and keep them in view. *The cliffs of the island were at this time very distinctly visible.* I watched one or two more parties follow in the same track; but I was not alone and could not stay long—my kind host was with me, and friendship forbade that I should weary him. It was not until the morning of the 9th, that I was at liberty to spend an hour or two in the same spot *in solitude*; and solitude, according to my experience, is almost essential to that patient watching which some of my Oxford friends call "taking the auspices."

As I left the house that morning, the hills were hidden in a soft mist, nor could I see anything of the Isle of Wight; it did not occur to me however at the moment that this might have some effect on the course taken by the birds. I was consequently rather taken by surprise, when I reached the cliffs about a mile west of Durlstone, and watched the first party that passed me, to find that instead of rising in the air and going out to sea, they turned back when they came near the headland, and still skimming close to the ground, and passing close to me as I sat sheltered from the wind under a wall, they made northwards over the hill towards the town of Swanage. After waiting a while, I saw another party take exactly the same course. They refused the sea-passage, and turned inland and northwards. The nature of the ground I was on prevented my watching them in this direction to any distance, and I could only stand there and wish that some kind wizard would turn me into a Swallow for but one hour, that I might follow in their track, and learn something of the ways and the minds of these little travellers. But it was a fair guess, that having refused the sea once, they would hug the land for some distance at least.

The sun had now come out, and I sat down to enjoy it while waiting for a third company of Swallows. All the birds I saw that morning, I may say, were Swallows, not Martins; and all of which I had a good view were young birds, so far as I could judge by their tails. Presently another series of ghostly little forms came gliding over me, and I at once jumped up and kept the binocular steadily on

them as they went eastwards. But this company did not return inland as the others had done; like the party I had watched two days before, they rose in the air when they neared the point, and circling higher and ever higher, as if observing and considering, they at length began to disappear over the sea. I scrambled over a high loose stone wall, at the risk of breaking my bones, in order to reach a higher point and keep them longer in sight; and then it was that I discovered that the *Isle of Wight had arisen out of the mist since I last was within view of it.*

I shall refrain from commenting on these facts, and from any hasty conclusions that might be based on them as to the mental operations by which these birds conduct their travel, till I have tried to see more at the same place next autumn. But I think I have told a story which may possibly induce others to help me in my observations, whether they live in the Midlands or on the coast. Wherever they may be, they will probably see something worth noting, if they watch all Swallows and Martins any time in early autumn.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

(Continued from page 77.)

Some curious results have been obtained in experiments upon the effects of various substances in stopping the growth of Bacteria. It is well known how difficult it is sometimes to get the larger species of Fungi to develop, and the same thing is true of the smaller kinds in a still higher degree. One of the most striking instances is found in the account which Raulin gives of *Aspergillus niger*; this is not indeed one of the Schizomycetes, but it is a pathogenic fungus, and in some respects similar to them.

To obtain the maximum growth no less than a dozen substances were needed: water, sugar, tartaric acid, nitrate and phosphate of ammonia, carbonates of potash and of magnesia, sulphates of zinc, iron, and ammonia, and silicate of potassium, all in constant and fixed proportions; the growth must also be maintained at a temperature of 35°C. and an abundance of moist air must have free access. The sulphate of zinc, *e.g.*, enters into this medium in only infinitesimal proportion, but if it were not present the fungus grew poor and died. On the other hand, the addition of an infinitesimal

proportion of nitrate of silver, viz., 1-1,600,000th part, abruptly stopped its growth and killed it. The growth could not even commence in a silver vessel. Equally fatal were one part in 500,000 of corrosive sublimate, one in 8,000 of bichloride of platinum, and one in 240 of sulphate of copper.

Another observer, Duclaux, sowed the spores of the Aspergillus on the same liquid nourishing material, in the one case with, and in the other case without, the tartaric acid; on the first a good crop arose in three days; on the other there was no growth. But, on the other hand, the liquid which contained the tartaric acid remained limpid and pure; no Bacteria developed in it: the second was turbid with the enormous numbers of Bacteria that crowded it. Add but a drop of tartaric acid to the second liquid, and the scene changes as by magic; the spores of the Aspergillus which have hitherto remained dormant begin to grow, soon take the upper hand, and produce as good a crop as in the other.

The true Bacteria are influenced almost as easily by the character of the circumstances in which they exist. They feed upon the substances that surround them, appropriating some of the elements themselves, and setting free the others to enter into new combinations. The result of their action is in the main akin to that which is called fermentation. In fact, Duclaux defines fermentation as "chemical transformations which dissolved substances undergo, under the influence of organisms, always devoid of chlorophyll, which develop and live in the interior of the liquid which is fermenting."

To show the kind of change which Bacteria can work we may instance the transformation of sugar into lactic acid, of lactic acid into butyric acid, of alcohol into acetic acid, of urea into carbonate of ammonia, of ammonia into nitrates, and of albumen into peptones. There can be no doubt that some of them play a very important part in the process of digestion, especially in the stomachs of herbivorous animals. Others produce colouring matters, red, blue, green, yellow, purple, pink, violet, brown, and, in fact, every possible colour; it is also believed that a microbe is the active agent in the production of indigo.

Putrefaction is now known to be but the result of many simultaneous and diverse fermentations, which go on in the decaying substance under the influence of Bacteria and a few other simple organisms. The most important fermentation is that which the Bacteria are capable of producing in complex organic nitrogenous compounds. If a substance, highly putrescible under ordinary circumstances, be sterilised

and preserved from the access of germs from outside, it will remain for ever almost absolutely unchanged, except for the loss of any volatile constituents. It will not decay, but the presence of a single Bacterian germ is sufficient to set up putrescence. The Bacteria do not all work simultaneously at this operation, but certain species appear successively, *Bacterium termo* being the first. Any proteinaceous substance, exposed to the air, is soon attacked by myriads of this species, but after a time they nearly disappear or diminish greatly in numbers, and their place is taken by other Bacteria, and by the Spirilla, or, as they are frequently termed, Vibrios. These, again, are succeeded by Monads, until finally the putrescible material is exhausted. Each organism lives by appropriating to itself the elements that it needs, and it seems that it leaves what it does not want in a condition to afford suitable pabulum for another species. The action is in general a molecular one, although it is possible that, in the case of the larger monads, the action may be partially mechanical, as stated by Dr. Dallinger. The ultimate result is to reduce the complex organic substance with which we started to its elements or to simple compounds, which are then free to unite again, and form parts of other organisms, perhaps higher in the scale of being. It is thus that life is rendered continuously possible on this earth.

The Great Advance.

The development of the Science of Bacteriology within the last decade is one of the most remarkable instances of the unexpected that can be found within the whole range of human knowledge. When we read of the state of this science ten years ago, how few species were then known, how little had been discovered about them, what enormous difficulties were found in doing more than merely observe and measure those species which were accidentally met with; when we remember the useless and unproductive controversies which raged about their specific value, their growth and development, and the questions of their spontaneous generation, and their connection with disease (controversies which were useless because sufficient data had not then been accumulated on which to found trustworthy conclusions), and when we contrast that state of darkness and confusion with the ease and certainty with which a Bacteriologist of the present day isolates, propagates, examines, experiments upon, and otherwise marshals and directs the almost invisible units of the armies with which he deals, we must confess that the

transformation offers one of the most surprising spectacles we can imagine of the great results arising from a single step.

That step in advance was the publication, in 1881, of Koch's discovery of the method of cultivating Bacteria upon solid nutrient gelatine. Let us consider for a moment the effect of this discovery, and the further steps which it renders practicable, or even easy, where previously an apparently insoluble difficulty had barred the way. In a natural state many kinds of Bacteria almost invariably occur together; even in cases where we may in all probability hope to get but one species, as for instance in the blood of a person who has died from some specific disease induced by a species of Bacteria (what is now called a *bacterian* disease), even then doubts are not prevented. We may get over all the difficulties of excluding other germs from our flasks, our nutrient solutions, our lancets, and our needles; we may use but a minute drop of the blood to be investigated; but after all, if two forms of Bacteria ultimately make their appearance in the liquid we are using, we have no guarantee that they came from the same original germ. Or again, when we take a drop of the solution, and with it inoculate an animal, if any disease makes its appearance in consequence, we can have no certainty to what the disease is to be attributed, since we cannot tell that there may not have been a species in the liquid that was used equally efficacious (or more so) in producing the observed result, as that which we intended to introduce.

But when the solid stratum is used and Koch's method followed, all this uncertainty becomes the plainest and most entrancing certainty. When we have obtained, by diluting with sterilised water, a drop of fluid in which the bacterial germs are few in number, we inoculate with this minute drop a few cubic centimetres of liquefied nutrient gelatine, mix the whole well together, and then spread it out in a thin layer upon a plate of glass. When it becomes solid, each germ will almost inevitably be isolated from its neighbours and, provided that the species is capable of growing in the substance and at the temperature we are using, each will proceed to divide and redivide in its own characteristic manner, and form, in a few hours or days, a little colony visible to the naked eye. If the dilution of the germs has been carried to a sufficient extent, each of these colonies will be at first distinct from the others which grow in its neighbourhood. By observing the stages of their growth under a low power of the microscope, and rejecting all that are irregular or

confluent with other colonies, we shall be quite sure that a minute particle, taken from one of these colonies, contains the products of only a single germ. That this assumption is justified by the facts can easily be shown. It is possible in this way to take any given species that will thrive under the conditions, and propagate it successively from plate to plate for any number of generations, always maintaining the same character (or the same combination of characters) both in the macroscopic and in the microscopic aspects of the colonies. There cannot remain the slightest loophole for doubt that we have obtained the required species "pure" and free from all admixture; moreover, we are able to rebut another objection that was frequently made to the old experiments, namely, that the cause of death where an animal was inoculated with Bacteria was not the organism itself, but some chemical substance which accompanied it. For, since the chemical substance being inorganic would be incapable of increase, while the Bacterium would multiply itself to any extent required, it is obvious that the ultimate result, after many successive cultivations, would be the entire elimination of the hypothetical chemical compound, and the production of a material in which the only element present, except the nutrient medium, was the organism under investigation.

It is of course necessary that, in all the manipulations required, precautions should be taken to exclude all foreign germs, but the methods of *sterilising* (as it is called) everything that is used—gelatine, flasks, plates, needles, etc.—by means of heat or steam or acid, are now so well understood and so successful, that no danger need be feared on this score. Moreover, we can use that principle, which is now so widely and so constantly employed, of a "control" experiment. For if we go through exactly the same manipulations with two portions of the material, but sow germs on the one but not on the other, and if we invariably see the one on which nothing was sown remain unchanged, while the other reproduces the organism with which we are experimenting, then we are entitled to conclude that our precautions for the exclusion of foreign germs have been entirely satisfactory. We are now in a position to investigate the morphology and biology of these minute organisms with the same certainty with which we can experiment with the seeds of Phanerogams.

One of the most curious practical applications of this principle of "pure" cultures is found, not indeed among the Bacteria, but in a group closely allied to them. One of the chief functions of Bacteria in the world is that of inducing fermentation; and their rôle in this respect is shared by the

Yeast-Fungi or Saccharomycetes. The various species of yeast can be cultivated like the species of Bacteria, in a modified form of plate cultivation. But the chief point to which your attention is directed is, that the object of the process in this case is a purely commercial one, or in other words it brings in money. English breweries often suffer from fluctuations in the quality and flavour of their beer. This arises from the fact that no yeast in ordinary use is pure; they all contain more than one kind of Saccharomycetes, as well as many kinds of Bacteria. The latter are really impurities, which sometimes increase so much in number that the yeast ceases to be of any value for the purposes of brewing.

This "degeneration," as it is called, has long been known to practical brewers, but being totally ignorant of the microscope, or even of the existence of Bacteria, they attributed the cause of it to all sorts of influences but the right one. The failure of the beer was assigned to the malt. the water, the hops, the temperature of the wort, etc., etc., and no two specialists in brewing could ever agree entirely as to what it was that caused the degeneration in any given case. Still they had invented a practical remedy for this state of things, which consisted in the periodic interchange of yeast between breweries in different localities. This interchange sometimes succeeded in renovating the yeast, and giving it a new lease of life. But it was always subject to risks, and when one obtained an "exchange" it was never possible to foresee whether it would be successful.

The cause of this difficulty obviously lies in the impurities which contaminate the yeast. Now by taking a small sample of good yeast, and diluting it largely with sterilised water, it is found that a tiny drop of the liquid taken up on the end of a glass rod, contains only a small number of yeast cells. This drop is introduced into a sterilised flask containing about 10 cubic centimetres of sterilised gelatinous wort—that is, ordinary brewers' wort mixed with gelatine. This gelatinised wort being melted and shaken, a small drop is spread evenly upon a microscopic cover-glass, and allowed to solidify; it is then placed over a moist cell on a microscopic slide, and kept at a temperature of 25°C. in an incubator. Each cell entrapped in the gelatine is watched beneath the microscope as it develops into a colony by budding, and every care is taken that any case where two colonies may have coalesced should be rejected. We can now select any pure colony, and transfer it to another similar flask. By removing the beer that is

formed and adding fresh sterilised wort, it is obviously possible to obtain a goodly supply of yeast. Finally this is transferred to a large apparatus where sterilised wort can be supplied in any quantity. and the pure yeast derived from a single cell is thus continually produced and drawn off as required for use. Throughout every operation, the precautions dictated by previous experience are taken to exclude the germs of "wild" yeast or of Bacteria. This process, invented by Dr. Hansen, a Continental brewers' microscopist, is now no longer an experiment. It is worked on a large scale in several breweries, with the most brilliant and commercially successful results. In these establishments "returns" are unknown; bottled beer leaves no sediment, and any desired flavour can be secured and maintained the whole year round.

(To be continued.)

THE WORK OF FIELD CLUBS.*

BY CH. CALLAWAY, D.SC., F.G.S.

In accepting the presidency of this Club, my desire was to promote amongst its members an interest in Nature. The Severn Valley abounds with specimens of her handiwork. Each creature that swims in the waters of our noble river. each flower that blooms on its banks, each hill that looks out over its verdant meadows, is a microcosm of wonders; and as the prophet beheld horses of fire and chariots of fire where the common eye saw nothing, so the true student of nature expatiates in a world of beauty and marvel which is invisible to the untrained sense. A Newton perceives laws where other men had seen only aimless motions. To a Darwin, a buttercup is a wonder whose glory derives a tenfold charm from the mysteries which still lie hidden in its nectaries or its carpels, but to most men it is a buttercup and nothing more. Surely it is worth making an effort to penetrate the secrets which hide themselves in the common objects that lie about us.

But I may be met by the objection that it requires a long course of study to fit the mind to look into Nature. This is by no means the case. Training is no doubt required—except perhaps by a Darwin—to qualify men to make important discoveries, but we must be content at first to learn what

* Presidential Address to the Severn Valley Field Club, delivered at Wellington, January 24th, 1889.

is already known, and this we can do without special qualifications. Unhappily, our schoolmasters have hardly yet begun to perceive that the great book of Nature—the stars, the mountains, the worlds of plant and animal life—is of more real interest and importance to living men than the correct scanning of Greek iambics, or the enunciation of the fact that the nearest distance between two points is a straight line. I am far from depreciating classics and mathematics. They have their place in a liberal education, but they have no right to supremacy, and I venture to affirm that a school, whether public or private, which does not teach natural science, is omitting that kind of instruction which is best adapted to give to the minds of its alumni solidity, breadth, and insight.

The esteemed President of the Caradoc Field Club, the Rev. J. D. La Touche, is attempting to promote original research in natural history amongst the members of his club. The object is most commendable, and in the Caradoc Field Club there are more men of sufficient competence to respond to his wishes than this club can supply, and for the present we must content ourselves with more modest work. Nevertheless, there are many fields of work in which we may acquire an intelligent knowledge of broad facts, or may even open up new veins of enquiry. Those who are interested in plants would find a world of marvels in the fertilisation of flowers. Mr. Darwin has shown that the vigour of plants largely depends upon the fertilisation of their ovaries by pollen from other plants of the same species. This pollen is usually conveyed by insects. Thus it is the interest, if we may so speak, of each plant that it shall be visited by as many insects as possible. Hence the numerous devices by which plants attract their visitors. The little tube with its store of honey is the chief allurement to the insect, but the perfume, the colour, the shape, of the flower are all concerned in facilitating the process of fertilisation; so that it is not too much to say that the wonderful beauty and variety of flowers have resulted from the need of cross-fertilisation. Every garden, every hedgerow, will provide us with abundant material for enquiry. Why has the rose separate petals, while in the primrose the petals are combined into a tube? Why is the flower of the pea irregular, while the corolla of the convolvulus is as regular as a funnel? These and ten thousand similar enquiries would stimulate the faculties and might lead to the discovery of new facts. The mere collection of specimens is, of course, a good training for the eye, and it tends to promote habits of accurate thought; but to search

into the causes of things is the chief aim of science; it is thus that we reach that inner laboratory of the universe where some knowledge may be gained of the actual working of her majestic laws.

But I pass on to that science of which I can speak with more familiarity. The geology of our county is probably unrivalled for the variety and interest of its phenomena. It attracts scientific men from all parts of the civilised world. A year rarely passes without visits from eminent strangers. It is to the great loss of Shropshire men and women if they remain in ignorance of the remarkable phenomena amidst which they live. Many, no doubt, are withheld from taking up the study by the difficulty of making a start. They are afraid that if they were to plunge *in medias res* they would be quickly overwhelmed with perplexities and discouragements. But the difficulties may not be so great as they anticipate. To rush at once into problems fit only for an advanced student would be unwise, but there are shallows in which they may paddle before they strike out for the deeper questions.

There are two ways in which we may approach the study of geology. Some thirty years ago I commenced to collect fossils, and this is, perhaps, the most frequent method of acquiring an interest in the science. At first, the fossils are mere curiosities; they are what stamps are to boys. But, after a time, we pass from the symbol to the meaning that underlies it; we are led to study the wonderful pages which record the history of successive dynasties of plants and animals; we learn how type after type has come into being, and, after giving rise to higher forms, has passed away; how each type has foreshadowed with ever-increasing distinctness the highest type of all, man; and how the law of progress from lower to higher forms in the inferior creation seems to prophesy hopeful things for the future of the human race.

But we may approach the study of geology from another side, the artistic or æsthetic. The dullest eye can see that our Shropshire scenery is beautiful. It needs no Ruskin to point out to us the graceful lines of Wenlock Edge, the elegant curves of the Wrekin, the serpentine meanderings of the Severn. But there is a meaning in every line of the landscape. Our mountains owe their form to the hand of the cunning sculptor, Nature, chipping, grinding, polishing, without pause or loss of skill, for countless ages. Compare together the semi-lunar ridges of the Wrekin or Caer Caradoc, the sharp straight line of Wenlock Edge, the hog's-back elevations of the Longmynd, the serrated outline of the Stiper Stones, the tabular summit of the Titterstone Clee,

the triple diadem of the Breiddens. Geology can tell you how these mountains have assumed their form. Why, at one spot, does the Severn wind about in loop-shaped curves, while in another it cuts straight through a mighty wall of limestone? Geology can answer your questions. North Shropshire is a plain diversified by a few low elevations, while South Shropshire rises into numerous mountain peaks and ridges. There are reasons for the differences, and geology can give them. But these are only a few of the problems which lie around us. The history of the humblest hill that rises above the Severn Valley opens up questions of profound interest. The very sand heap, from which we cart the materials for our garden soil, tells us of the time when the Wrekin stood as an island amidst the waters of an archipelago, and the ice-floes from the North scattered their stony burdens over what is now the plain of Shropshire. The red gravel with which we pave our walks in Wellington takes us back to an epoch inconceivably more remote, more ancient even than the period when the Archæan volcanoes of Shropshire poured forth their lavas, probably to the time when no plant or animal had come into being on the earth. Every stone in a wall, unless it be a brick or a piece of slag, has a history infinitely more ancient than that of Egypt or Babylonia; every slate on our roofs takes us back almost to the advent of life on our globe. To the geologist, there is meaning in the very dust. Believe me that the study of the stones is not so difficult and dry as is commonly supposed. To associate an earnest enquiry into Nature with the less serious pleasures of our club meetings will give them purpose and dignity. To the lighter music of the Fauns and the Dryads let us add the lofty chords of Apollo's lyre. Though the members of this club may meditate the sylvan muse "*sub tegmine fagi*," there is no reason why they should do it "*tenui avenâ*."

WILD BEES.*

BY R. C. L. PERKINS,

JESUS COLLEGE, OXFORD.

Bees constitute a portion of the very extensive order *Hymenoptera*, and, together with the ruby wasps (*Chrysididæ*), ants (*Heterogyna*), *Fossores*, and true wasps (*Vespidæ*), form that division which is termed the *Aculeata*. They themselves

* Read before the Oxford Natural History Society, February 19th, 1889.

form a very well-marked and distinct group, the *Anthophila*. which in this country consists of about two hundred species. According to their habits we may divide them into the "solitary" species and the "social," the latter division, excluding the hive bee, consisting only of the *Bombi* or humble bees. The solitary species excavate cylindrical burrows in the soil, in wood (decayed or sound), and various other substances. The cells formed within these, wherein the food for the larvæ is stored, in the simplest cases (*Andrena*, &c.) consist merely of a portion of the burrow with the sides very carefully smoothed by the insect's tongue; or they may be plastered with several coatings of a secretion which dries quickly and forms a very delicate and glittering lining (*Colletes*); or they may be formed of pieces cut from various kinds of leaves, which keep the larval food from contact with the sides of the burrow; and sometimes within the leafy walls there may be a lining cut from the brilliant scarlet or pink petals of the garden geraniums (*Megachile*). Another of our bees (*Anthidium*) encloses its cells in a soft downy covering composed of the hairs of the stems and leaves of *Stachys* and other plants which it scrapes off with its mandibles.

The burrows may be simple tubes, and the cells placed one above the other, with partitions formed between each; or short lateral tubes may be found in communication with the main tube, and usually at the blind end of each of the lateral branches is one single cell. Each cell contains a little, rounded mass of pollen, its size proportional to the species by which it is stored, and it is moistened with a greater or less amount of honey.

Two or more individuals never co-operate either in forming or in supplying the cells, but each is quite independent of its neighbour, and keeps to its own burrow when once it has entered upon the task of providing for its young. On the other hand, the social species (*Bombus*) form communities, the members of which mutually assist one another in building their nest and attending to the young brood.

All bees, however, do not gather food for their young: a number of genera are parasitic, and these enter the burrow or nest of the industrial kinds and deposit their egg within, on the pollen which the industrial bees have gathered.

It is necessary in considering the habits of our wild bees to examine a few of the more important structural characters. In most cases the pollen is collected on the hind legs, especially on the joint called the *tibia*. The apparatus for this purpose is not the same in the solitary species as in social ones; in the former the *tibiæ* are covered, especially outwardly,

with a dense clothing of hairs, which is known as the *scopa* or pollen brush, and in some genera, *Anthophora* for example, this covering is continued over the basal joint of the *tarsi* as well.

In the social bees the hairs on the *tibiæ* are so arranged as to form a kind of basket in which the moistened pollen is carried, and this structure is known as the *corbiculum*. The *tibiæ* themselves on their external surface, are smooth and slightly concave, the curved stiff hairs being set along the margins.

The parasitic species have no apparatus for collecting pollen, and a few industrial genera, *Prosopis* and *Ceratina* for instance, have the same deficiency, or at least are but ill adapted for the purpose; the bees belonging to these two genera store up a semi-liquid honey in place of the usual pollen mass.

But it is not on the *tibiæ* alone that there is a special arrangement for gathering pollen. In some bees a pollen-brush is situated on the terminal abdominal segments beneath, and it is noticeable that these have the most highly developed instincts and the most interesting habits of all our British species. These, then, are the most important structures for pollen gathering, but many other parts assist in the work. The long "*floccus*" on the trochanter of *Andrena*, and the thoracic hairs may be mentioned, especially those on the sides of the metathorax, which in some species are very long and curved, and beautifully plumose, as in *Andrena dorsata* for instance, and which are often loaded with pollen. Indeed, some species cover themselves so entirely as to be hardly recognisable, particularly those which frequent the blossoms of *Hieracium* and other yellow *Compositæ*. *Andrena humilis* is a remarkable instance of this, for hundreds of these bees may be seen on a fine day round a populous colony, each one appearing entirely yellow from the covering of pollen collected from the hawk weeds.

Every one knows how important insects are for the fertilisation of flowers; and bees, since their food is entirely obtained from this source, are the most important agents in this work, and in general are the best adapted for it, because of their hairy exterior and the peculiar character of these hairs. Certainly, though bees are greatly indebted to flowering plants, the latter derive the greatest benefit from the visit of bees, and I imagine that a bee can rarely visit a flower without effecting that object, which the plant, by the attractions it offers, has striven to attain. One must also take into account the methodical habits of bees in visiting one kind of flower at a time, and not first one species and then

another. In this respect they seem to surpass all other groups of insects.

Some of our species, indeed, appear to restrict their visits entirely to one species of flower. *Andrena florea* appears to visit only the blossoms of the briony (*Bryonia dioica*), and two other species of this genus (*A. Hattorfiana* and *Cetii*) are only found on the common Scabious (*Scabiosa arvensis*). Moreover, a very large number of our bees, though they visit different flowers in different localities, yet confine their attention to one species in any one locality; and though some species of bees visit a considerable number of different flowers, yet *the individuals* of these species, only in very rare instances, visit first one kind of flower and then another.

All bees have, on some parts at least, branched or feathery hairs, amongst which the pollen grains are readily caught, and these are the most common kind of all.

Another very common form of hair, is marked by a spiral thickening, and is found more or less numerously in the pollen-brushes on the *tibiæ*, and it is of this kind of hair that the ventral pollen-brushes are composed. On the *tarsi* may be found broad, flat hairs, or hairs with dilated and flattened *apices*, for removing the pollen which adheres to the body.

The only other structure which I need refer to is the tongue. In its least developed (*Colletes* and *Prosopis*) form in bees, it closely resembles that of the wasp, as one would expect from the fact that the bees follow next after the wasps in the natural order: in these it is short, broad, and bilobed at the apex. In the genera *Anthophora* and *Bombus* it reaches its greatest development, so that some of these species are enabled to obtain the nectar from the honeysuckle and other flowers which no other of our bees can reach. Between the long slender organ of these two genera and the short wasp-like tongue of *Colletes* is a long series of intermediate stages in development.

Turning now to the enemies of bees, a few may be noticed here which are more or less indiscriminate in their attacks. Others which are only obnoxious to the genera I have selected for this paper, or are more obnoxious to these than any other, will be discussed under those genera.

To pass over the insectivorous birds and other vertebrates, some of which destroy a considerable number of these insects, there is one enemy from the attacks of which few of our wild bees are altogether exempt.

I am alluding to the *Forficulæ*, commonly called earwigs, and the destruction they cause of such species as form colonies can hardly be estimated. Last year, for instance,

these creatures were more than usually abundant, so that I was able to fully realise the extent of their attacks on several colonies of a species of *Halictus* (*H. rubicundus*, *Chr.*). These bees emerge in August, and the females hibernate, laying their eggs in spring and early summer. In August I examined hundreds of burrows of *H. rubicundus*, which at this time should have contained pupæ and freshly-emerged bees, but not one was to be seen. There were still a few old and battered specimens of the previous year, and many more dead and attacked by mould. This much was due to the weather, but in all such cells as had been stored, instead of pupæ or bees, there were *Forficulæ*, and here and there a fragment of pollen not as yet quite devoured. Larvæ, pupæ, young bees, and pollen all disappear before these destroyers, while the burrows afford them a secure retreat; and when they have demolished the contents of one cell they crawl on to the next and do the same.

Spiders, too, devour large numbers of bees. Most entomologists must have noticed the species which lurk in or on flowers, and how beautifully many of them assimilate with the colour of the part on which they remain motionless: daisies, buttercups, mallows, and *Hieracium*, &c., are much frequented by them. When a bee (or in fact any insect) alights the spider springs on it, and either devours it on the flower or drops to the ground and carries it off. Species as large as the larger *Andrenæ* are captured in this way by spiders of comparatively small size. The Fossor *Philanthus* also carries off bees bodily to provision its cells, while ants will carry off the smaller species as they alight at their burrows. Other *Fossores* also occasionally carry them off for a similar purpose. Parasitic *Diptera* may often be seen cautiously entering when the bee is abroad, in order that they may deposit their eggs, and the larvæ proceeding from these devour the larvæ of the bee. The same is true of various species of *Coleoptera*.

(To be continued.)

FORAMINIFERA OF OBAN, SCOTLAND.

BY E. W. BURGESS.

(Continued from page 81.)

21. *Textularia gramen*. D'Orbigny, 1846.
Balkwill and Wright (I. F.), 1885, p. 332, pl. xiii., figs. 13-4.

Balkwill and Millett (G.), 1884, p. 17.
A short broad, textularian form. Common.

22. *Gaudryina filiformis.* Berthelin, 1880.
Wright, J., Proc. Bel. Nat. Field Club (1880-1). Appendix, p. 180, pl. viii., figs. 8, 8A, 8B.
Balkwill and Millett (G.), 1884, p. 7.
Robertson, D., Portree Bay, abundant.
J. Wright says: "An elongated sandy *Gaudryina*, with later chambers sub-quadrate; often in a fragmentary state, the loose sandy texture of its test making it liable to be easily broken." Rather rare.

23. *Verneuilina polystropha.* Reuss, 1845.
Williamson (R. F.), 1858, p. 65, pl. v., figs. 136-7.
Balkwill and Millett (G.), 1884, p. 7.
Robertson, D. (W. S.), 1874, common.
An arenaceous form (Bulimina), varying in texture, generally of an orange or brown colour. Very common.

24. *Bulimina pupoides.* D'Orbigny, 1846.
Williamson (R. F.), 1858, p. 62, pl. v., figs. 124-5.
Robertson, D. (W. S.), 1874, frequent.
An indistinct spiral form of numerous well-developed segments. Frequent.

25. *Bulimina marginata.* D'Orbigny, 1846.
Williamson (R. F.), 1858, p. 62, pl. v., figs. 126-7.
Robertson, D. (W. S.), 1874, common.
An easily recognised form, sometimes very short, often elongated; the convolutions either serrated or crenulated on the smaller edge. Common.

26. *Virgulina Schreibersii.* Czjzek, 1847.
Williamson (R. F.), 1858, p. 63, pl. xiii., figs. 18-21.
Robertson, D. (W. S.), 1874, frequent.
The segments are longer and fewer than in the *Buliminas*, and of a textularian character. Frequent.

27. *Bolivina punctata.* D'Orbigny, 1839.
Brady, H. B., 1864, Trans. Linn. Soc., London. Vol. xxiv., p. 468, pl. xlviii., fig. 9.
Robertson, D. (W. S.), rare.
A slender textularian form, often twisted. Frequent.

28. *Bolivina plicata.* D'Orbigny, 1839.
Brady, H. B., Ann. and Mag. Nat. Hist., Ser. 4, Vol. vi., p. 302, pl. xii., figs. 7A-B.
Robertson, D. (W. S.), 1874, rare.

This textularian form has four rows of longitudinal markings on the test, involved or plaited, the angle of one side in the curve of the other.
Very common.

29. *Bolivina difformis.* Williamson, 1858.
Williamson (R. F.), 1858, p. 77, pl. v., figs. 166-7.
Brady, H. B., 1884. Challenger report, p. 421, pl. liii., figs. 5-6.
Balkwill and Wright (I. F.), 1885, p. 335.
As Messrs. Balkwill and Wright observe: "A true *Bolivina*, having the longitudinal, notch-like aperture, common to all the *Bolivinæ*." H. B. Brady remarks: "If so, the *Bolivina pygmæa*, Challenger Report, may be merged into the same species." Rare.

30. *Bolivina dilatata.* Reuss, 1849.
Williamson (R. F.), 1858, p. 76, pl. vi., figs. 164-5.
Robertson, D., Portree Bay, 1880.
A much broader form than the former ones, with a very acute edge. Frequent.

31. *Cassidulina lævigata.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 68, pl. vi., figs. 141-2.
Outline very circular, form lenticular or biconvex.
Rare.

32. *Lagena globosa.* Montagu, 1803.
Williamson (R. F.), 1858, p. 8, pl. i., figs. 15-6.
Balkwill and Wright (I. F.), 1885, p. 336.
Robertson, D. (W. S.), 1874, frequent.
Mr. J. Wright draws attention to the globular Lagenæ, "the apertures of which are respectively stellate and fissurine," and restricts the stellate aperture to *L. globosa*, the fissurine aperture to a round form of *L. lævigata*, Reuss. Frequent.

33. *Lagena lævis* var. *clavata.* D'Orbigny, 1846.
Williamson (R. F.), 1858, p. 5, pl. i., fig. 6.
Balkwill and Millett (G.), 1884, p. 10.
Fusiform in shape, with long neck, and, as J. Wright points out, a milled rim at the aperture.
Frequent.

34. *Lagena gracillima.* Seguenza, 1862.
Robertson, D. (W. S.), 1874, common.
A more lanceolate form than the last, both ends acuminate. Frequent.

35. *Lagena sulcata.* Walker and Jacob, 1798.
Williamson (R. F.), 1885, p. 5, pl. i., fig. 8; p. 6, pl. i., fig. 10; p. 7. pl. i., fig. 11.

Balkwill and Millett (G.), 1884, p. 9.
Balkwill and Wright (I. F.), 1885, p. 338, pl. xiv., figs. 1-2.
Wright, J. Recent Foraminifera, Down and Antrim, p. 103, pl. iv., fig. 10. Proc. Bel. Nat. Field Club. Appendix, 1876-7.
Robertson, D. (W. S.), 1874, common.
Oban, 1888. Frequent.

36. *Lagena Williamsoni.* Alcock, 1865.
Alcock, 1865. Proc. Lit. and Phil. Soc., Manchester. Vol. iv., p. 195.
Mr. J. Wright, 1877. Proc. Bel. Nat. Field Club, 1876-7. Appendix, p. 103, pl. iv., figs. 11-13.
Balkwill and Wright (I. F.), 1885, p. 339, pl. xiv., figs. 6-8.
A well-marked form, the lower part of the neck distinctly ornamented with hexagonal reticulations. Common.

37. *Lagena striata.* D'Orbigny, 1839.
Williamson (R. F.), 1858, p. 7, pl. i., fig. 14.
Balkwill and Wright (I. F.), 1885, p. 337.
Robertson, D. (W. S.), 1874, common.
Mr. J. Wright remarks that there are two well-marked forms of this species, one elongate, with very delicate longitudinal striæ, the other larger, more globular.
There is an exceedingly great variety of form and size of striæ, in both the *L. striata* and *L. semi-striata*. Common.

39. *Lagena gracilis.* Williamson, 1848.
Williamson, 1848. Ann. and Mag. Nat. Hist., Ser. 2, Vol. i., p. 13, pl. i., fig. 5.
Williamson (R. F.), 1858, p. 7, pl. i., figs. 12-3.
Appears to be a finely striated variation of *L. lævis.* Rare.

40. *Lagena squamosa.* Montagu, 1803.
Williamson (R. F.), 1858, p. 12, pl. i., fig. 29.
Balkwill and Wright (I. F.), 1885, p. 340, pl. xiv., fig. 9.
Robertson, D. (W. S.), 1874, frequent.
A lagena that varies very much in every way—in form, size, and also both in shape and arrangement of the areolæ. Frequent.

41. *Lagena hexagona*. Williamson, 1848.
Williamson, 1848. Ann. and Mag. Nat. Hist., Ser. 2, Vol. i., p. 20, pl. ii., fig. 23.
Williamson (R. F.), 1858, p. 13, pl. i., fig. 32, fig. 30.
Robertson, D. (W. S.), 1874, frequent.
A variety of *L. squamosa* in which the areolæ are regular hexagons. Rare.

42. *Lagena lævigata*. Reuss, 1849.
Robertson, D., 1883. Trans. Geol. Soc., Glasgow, Vol. vii., p. 24.
Balkwill and Millett (G.), 1884, p. 18, pl. ii., fig. 6.
Outline pyriform, rather narrower toward the fissurine aperture; compressed. Frequent.

43. *Lagena lævigata* var. *lucida*. Williamson, 1858.
Williamson (R. F.), 1858, p. 10, pl. i., fig. 22.
Balkwill and Millett (G.), 1884, p. 12, pl. ii., fig. 7.
Balkwill and Wright (I. F.), 1885, p. 340. Rare.

(To be continued.)

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

A meeting of the Committee of Management of the Midland Union was held on the 17th of April, at which the arrangements for the Annual Meeting in the summer were discussed. It was finally determined to make a change in the method of holding the Meetings, so as on the one hand to diminish the labour and also the pecuniary risk for the Society of the town where the Meeting is held, and on the other to make the programme more suitable to the wants of those members who can only spare one day to the Meeting, and of those who can attend the whole, as well as of those who coming from the longer distances yet do not wish to give up the whole of two days. It is therefore proposed that on the afternoon of the first day of the Meeting there shall be an opportunity for seeing the local objects of interest; that the business meetings shall take the place of the Conversazione in the evening, and that the Excursion or Excursions on the next day shall start at such an hour as shall permit of the members who live near taking part in them, and yet shall get back in time for the visitors to get away by evening trains.

It will be seen that the labour for the local Society is by this means reduced to the very small amount necessary to arrange an interesting route for an excursion and to order the vehicles.

It is intended to hold the first Meeting under this plan at Rugby, probably early in July, but the date will be finally determined a little later.

The subject of the Secretaryship of the Union was also discussed. Mr. Lawson Tait undertook the post of Honorary Secretary; while in order to relieve the present Secretary of the office, which he has for some time wished to resign, the Committee appointed (subject to his consent, which however has not yet been definitely given) a gentleman to act with him for this year, with the intention of after that taking the office altogether.

The Secretary was directed to request each Society in the Union to contribute at least one paper in the year to the "Midland Naturalist."

A list of gentlemen to be asked to act as adjudicators for the Darwin Medal was then drawn up.

Wayside Notes.

"THE MIDDLE LIAS OF NORTHAMPTONSHIRE."—The interesting papers which have appeared under this title in the pages of this magazine have been collected and reprinted, with additions, in a compact volume, which is published by Messrs. Simpkin, Marshall and Co., London, price 3s. 6d. The subject is considered under the following heads:—(1) Stratigraphically, (2) Palæontologically, (3) Economically, (4) As a source of water supply, and (5) As a mitigator of floods. The author is Mr. Beeby Thompson, F.G.S., F.C.S., of Northampton.

FLORA OF DERBYSHIRE.—The Rev. W. Hunt Painter, a well-known botanist, has issued a circular announcing the speedy publication of a Flora of Derbyshire on which he has been engaged for some years. It is intended to serve as a companion volume to "Cybele Britannica," the "Compendium" thereto, and other publications of the late Mr. H. C. Watson, as well as to the "Flora of the Lake District," by Mr. J. G. Baker, F.R.S., F.L.S. The book will contain an introductory chapter on the Geology of Derbyshire, and an account of its Botanical Bibliography. All the local critical genera have, we are informed, been submitted to botanists who have made a special study of them. A map of the county will be given. The price to subscribers will not exceed 5/6; after publication the price will be 7/6. Any of our readers who may desire to possess this book should send in their names, without delay, to the author, the Rev. W. H. Painter, Knypersley, Congleton. The Duke of Devonshire, Lord de Tabley, Professor C. C. Babington, Mr. J. G. Baker, and many other botanists of eminence have already given their names as subscribers.

A TRAVELLING NATURALIST.—It will, we think, interest our readers to know that Mr. E. W. Burgess, whose paper on the Oban Foraminifera is now appearing in these pages, is a member of the D'Oyly Carte Travelling Opera Company, recently performing at Birmingham, and that he has to seize his opportunities of studying Natural History during the intervals of his travels through the kingdom. Mr. Burgess

has made the Foraminifera and the Diatoms his special subjects; and, through the friends he has made in all parts of the country, he is enabled to have access to the various helps he needs in all the more important towns. But, out of London, he informs us, there is no town which offers to him such great advantages as Birmingham through its Natural History Society, and in the use of books, microscopes, &c. In Manchester, the Zoological Department of Owens College; in Edinburgh, the Laboratory of the Botanical Gardens and the Chambers Street Industrial Museum; in Glasgow, the Hunterian Museum and the Botanical Department of the University; in Dublin. the Museum and the Library of Trinity College; and in a few other places similar smaller institutions, whose resources are placed at his disposal by the kindness of officials and friends, have all assisted him in his studies; but none of them can be compared, for convenience and help in actual work, with the Birmingham Society's room. Mr. Burgess also says that he has found the Free Libraries in most large towns wonderfully useful.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION, Feb. 18th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Stone read the eighteenth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Interpretation of Evolution." A lengthy discussion followed on the subject of nitrogenous compounds, it being contended that they form an exception to the law that motion is dissipated during integration as they produce cold during combination, and contain so much motion when combined.—Feb. 26th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes was re-elected president, and Mr. Herbert Stone secretary for the ensuing year. Mr. Grove exhibited for Miss Gingell, of Dursley, *Ag. velutipes*, *Merulius Corium*, *Peziza coccinea*. Mr. Bagnall exhibited for Miss Gingell, *Eurhynchium crassinervium*, *Fissidens cristatus*, and *Galanthus nivalis* from near Dursley. Mr. Stone exhibited *Marsilea macropas*, the Nardoo plant, a Hepatic from Queensland. Mr. Grove read his paper on "Evolution in General," dealing with the five chapters of Mr. Spencer's "First Principles," XIII.—XVII., in which he expounded the law as it related to each phase of existence, the Inorganic, Organic, and Superorganic.—March 8th. Mr. Alfred Browett in the chair. The chairman called attention to the lecture recently delivered by Dr. Dallinger, at the Midland Institute, upon "Researches into the Infinitesimal, with their Bearings on Evolution." Also to a paragraph which appeared in the *Pall Mall Gazette* concerning the Section. Miss Goyne gave her exposition of the nineteenth chapter of Herbert Spencer's "First Principles," entitled the "Instability of the Homogeneous."—March 26th. Mr. W. B. Grove, M.A., in the chair. The president announced that Bennett and Murray's Handbook of Cryptogamic Botany had been presented to the Society. A vote of thanks to the donor was carried. Mr. Stone read, for Mr. Hughes, a letter which recently appeared in the *Pall Mall Gazette*, from Sir Philip Magnus, in reference to the formation of a Spencer Society in London. Mr. Bagnall exhibited *Fissidens bryoides* from Coombe Woods, Coventry, with microscopical preparation. For Miss Gingell, *Encalypta vulgaris*, *Polytrichum aloides* var. *minus*, and *Barbula aloides*, with microscopical preparation of same; all from Dursley, Gloucestershire. Mr. Stone exhibited, for

Mr. Hughes, four photographs of Cingalese plants of great beauty. The subjects were respectively: Fan Palms, Talipot Palms in flower; avenue of Cocos Palms in the Peradenyia Gardens, Kandy; and Giant Tree Ferns. These were received by Mr. Hughes from Mr. Councillor Clayton, from Ceylon. Mr. Bagnall read a long and interesting description of the photographs with an account of the uses of the plants. Mr. Grove exhibited *Œcidium lapsanæ*, the first of the season. Mr. Stone exhibited microscopic preparations of *Sphagnum cymbifolium*, found under nine feet of gravel at Small Heath. Also drawings of Cotyledons of Primula, including six abnormal forms. These were drawn from a batch of seedlings fourteen in number, eleven of which were more or less abnormal, varying in five different ways.—March 28th. Mr. A. Browett, F.G.S., in the chair. Mr. Colbran J. Wainwright gave his exposition of the twentieth chapter of Mr. Herbert Spencer's "First Principles," entitled "The Multiplication of Effects." In his paper, which was of fifty minutes' duration, Mr. Wainwright discussed the subject in a very thorough and able manner, mainly in its connection with the previous one, "The Instability of the Homogeneous," and argued that if absolute homogeneity were perfectly stable, as stated by Mr. Spencer, then our reasoning must commence with heterogeneity of some kind in order that change may be assumed to take place; consequently it was unnecessary to assume that homogeneity of any kind was unstable, for, given heterogeneity of even the simplest character, the multiplication of effects was by itself sufficient cause for change. A long discussion, which was adjourned from the lateness of the hour, followed, in which the Chairman, Miss Byett, and Mr. Stone took part.—BIOLOGICAL SECTION, April 9th. Mr. Charles Pumphrey in the chair. Mr. J. E. Bagnall exhibited *Vaccinium intermedium*, and *Sphagnum cuspidatum* var. *plumosum*, both new to Warwickshire; also, for Miss Gingell, *Helleborus fœtidus*, and *Adoxa moschatellina*, from Dursley. Mr. Alfred Heneage Cocks, F.Z.S., of Great Marlow, then read a most interesting paper, illustrated by diagrams and specimens, "On the Fin-whale Fishery off the Lapland Coast."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 18th. Mr. H. Hawkes exhibited *Docophorus atratus*, parasite of rook, also *Anguinaria anguina*; Mr. Dunn, *Nitella translucens*.—March 25th. Mr. Madison showed specimens of *Bulla cylindrica*, from Singapore; Mr. J. Moore, gizzard of black ant. Mr. A. Camm then read a paper—"Notes on Fungi." The writer said fungi were generally despised as having, with a few exceptions, poisonous properties, but when they were better understood they would furnish many new dishes for the table. The sections he purposed dealing with were those of the Myxomycetes and Discomycetes, microscopic forms that would rival in beauty and colour many favourite objects. The writer mentioned a large number that were specially suitable as objects for the lower powers of the microscope. The latter part of the paper dealt with the collecting of fungi, and the importance of keeping each kind by itself, and the localities in the district that have proved particularly prolific in these objects, some of them yielding as many as twenty-six species in an afternoon's work. The paper was illustrated by a collection of specimens, and some objects under the microscope.—April 1st. Mr. J. W. Neville exhibited specimens of *Olenus scarabæoides*, a Trilobite from the upper Lingula Flags, near Bala, and specimens of *Orthis lenticularis* from the same formation; Mr. C. P. Neville, a

collection of shells from the Straits of Magellan; Mr. J. Madison, *Bulimus pacificus*, from Queensland, also *B. arelaira* and *Corbicula nepeanensis*, from New South Wales.—April 8th. Mr. W. H. Bath showed a specimen of the great green grasshopper, *Phasgonura viridissima*, from St. Albans; Mr. A. Camm, a fungus, *Virgaria nigra*; Mr. J. W. Neville then gave an exhibition of lantern pictures of "Pond Life." They comprised a series of drawings of the Infusoria, Rotifera, Polyzoa, Entomostraca, and other interesting slides, including nest of stickleback, homes of water spiders, &c., &c. A short description of the life and habits of the different objects was given.—April 15th. Mr. C. P. Neville exhibited a collection of Silurian corals from Wenlock and Benthall Edge. Mr. J. Moore read a paper on "Simple Methods of Staining." The process adopted by the writer was simple in the extreme, only two dyes being used, an aniline dye and logwood, to both of which a little alum should be added. Any of the aniline dyes would answer the purpose, but he gave preference to magenta and green. Every degree of intensity could be obtained by strengthening or diluting the solution. If the colour was found too intense it could be reduced by soaking in spirits of wine. Objects stained with aniline dye could be mounted in Canada Balsam; and those coloured with logwood, in glycerine or glycerine jelly. A number of objects stained by this process were shown; they consisted of palates, wood sections, and insect preparations, and had been mounted for five years.

OXFORDSHIRE NATURAL HISTORY SOCIETY.—Tuesday, April 2nd, 1889; Rev. J. W. B. Bell in the chair. The Secretary read a letter from the President, Mr. E. B. Poulton, stating that arrangements were being made with the editor of the "Midland Naturalist" to publish a selection of the Society's lectures in that magazine, and he therefore suggested that a considerable number of members would like to take it in. The meeting was a small one, owing to its being vacation, but a list of twelve subscribers was made out. Mr. Henry Balfour then gave a lecture on the "Finmarken Whale Fishery." Briefly describing the two genera of whales—the Right and the Fin whales, he said that while the former were hunted in the Greenland fishery, the latter, which are much larger animals, alone appeared off the coast of Finland; they are called Rorquals. There are several species. An average size is sixty to eighty feet long, and some are even longer. To the Greenland fishery, as all knew, large ships went out, and the whales were harpooned from small row boats. The Finmark whales, on the other hand, are hunted from small 80 to 100 ton steamers, having a powerful harpoon gun fixed on a swivel in the bows. The harpoon itself was a terrible weapon of steel, six feet long, and carrying in its point, besides barbs, a shell, which was made to explode within the animal after it had been struck. A small model of one of these instruments was shown, and a whale hunt vividly described. The dead whale is towed to shore at the whaling station. The process of cutting off the blubber and rendering the oil was also gone into, and all the surroundings of a whale factory explained. The whale fishery is a very interesting study for a naturalist, and a visit to its head quarters gives one a pleasant voyage along the coast of Norway, round the North Cape to Finland. It has only one drawback—a whaling station is excessively mal-odorous; but the enthusiastic naturalist will not mind this. The lecture was illustrated with diagrams, pictures, and specimens. Everyone has heard something of the Greenland whale fishing, but this account of the Finmarken fishery, like the industry itself, is new to most people.

WILD BEES.

BY R. C. L. PERKINS,

JESUS COLLEGE, OXFORD.

(*Continued from page 116.*)

Andrena.

This is the most extensive of our British genera, comprising no less than forty-eight distinct species, and, therefore, there is naturally great diversity of appearance between many of them. They are of simple habits and universal distribution, and many are amongst the commonest of our wild bees. They form cylindrical burrows in the ground, some species preferring bare spots, others grassy banks; some will make their nests in pathways so hard-trodden that no one would imagine it possible for any bee to pierce the soil, others are partial to loose sand or the finely-sifted soil of a garden flower-bed, while others again will burrow in the stiffest clay. These burrows are just of sufficient size to admit the maker, and reach usually to a depth of from about five to nine inches.

Most of the species form "colonies" of greater or less extent. Sometimes they are so large that a space of some yards will be riddled with burrows almost touching one another; yet there is no division of labour amongst the individuals of the colony, such as we see in the social bees, but each keeps to its own *nidus* and takes no notice of its neighbours.

The cause of this gregarious habit is obscure: it may have originated from need of protection. Certain enemies may be intimidated by the numbers which are always to be seen round a vigorous colony. At any rate, in the case of *Anthophora*, another genus which forms huge colonies, this is probably the case, and I know that many people unacquainted with these bees would hesitate before approaching very close to one of the enormously populous colonies of *Anthophora acervorum*.

On the other hand, I have already mentioned the ravages of the *Forficulæ*, to which colonies are especially exposed, and, similarly, insectivorous birds not unfrequently pay them visits.

There is some reason to think that in some cases at any rate the sole cause of such colonies lies in the fact that the

place chosen at first is very suitable to the species, and that the descendants of the first comers continue to make use of this very favourable spot, so long as there remains room for their increasing numbers.

The striking difference between the male and female in general appearance in some species is noteworthy. No one, for instance, would ever guess that the male and female of *Andrena fulva* belonged to the same species. Many of, if not all, the species of *Andrena* will emit a more or less powerful scent on being handled, which is often, but not always, of a pleasant nature. This power is by no means peculiar to this genus, but is rather the rule throughout the genera of bees than the exception; nor is it confined to one sex as in many other insects, *Pieris napi* for instance, in which the male alone has acquired this property. For I know from my own observations that, in many species at any rate, both sexes have this power, but in the case of many others, the males of which I have noticed as emitting a powerful odour, I have not examined the live females in the field to asertain whether they also have this same power.

With regard to the species of which *both sexes* emit an odour, and I believe most bees belong to this class, we can hardly be wrong in assigning a protective value to this property. It must be remembered that although to a hymenopterist a bee is a bee, and in appearance very distinct from other insects, yet there are many enemies of insects which would not distinguish perhaps even most bees from flies; and further, it is of course the females only of bees which possess a sting, so that the males, especially when they possess an appearance rather distinct from the other sex, would be very liable to be preyed upon. But even if the scent of the male was not in itself disagreeable to certain enemies, it is highly probable that in cases where it is of a similar nature in both sexes the enemy would associate the particular scent with the idea of something harmful, and so the male would escape although without a weapon of defence. Such a means of escape, too, is all the more important, when we consider, that the males of bees emerge generally a week or ten days before the appearance of the other sex.

Of the special enemies of the *Andrenæ* there are the brightly marked parasitic bees of the genus *Nomada*. They are amongst the most interesting of our native bees. Many of the species are very similar in general appearance to wasps, having bright yellow bands on a black or brown ground colour, the rest are black and brown, often with minute yellow markings.

But before entering into a discussion of these colours, it is better to speak of the attacks of the *Nomadæ* on the *Andrenæ*.

It is generally stated that they are allowed by the *Andrenæ* to enter their burrows "without let or hindrance," and, in a way, this would seem to be correct. But it should be noticed that these parasites are extremely cautious in entering a burrow, hovering for a time at the mouth, or often entering a little way, and then flying off to another; without doubt, such behaviour is due to their fear of encountering the *Andrena*, if at home. On the other hand, if the *Andrena* returns when the parasite is within, as must sometimes happen, she waits until the latter has flown off: so that both, it would seem, equally avoid an encounter.

Another reason for this belief is found in the fact that (except of course when recently emerged from the pupa stage), the *Nomadæ* do not rest at night or in bad weather in the burrows of the *Andrenæ*: but above the surface of the ground.

Shuckard, in his "British Bees," noticed that while a colony of bees would continue to abound in about equal numbers year by year, their parasites would be abundant one year and very rare another. He did not however see the cause of this, and I am not aware that it has been mentioned by any of our other hymenopterists. It is certainly because they are thus exposed to all weathers, that the great variation in their numbers in different seasons is due: while bad weather does not *equally* affect the *Andrena*, which is sheltered in its burrow.

Even the habit among parasitic bees of sleeping out seems hardly to have been observed, though other genera besides *Nomada* do so—for instance, *Melecta*, which I have frequently found so circumstanced on the wettest days, and *Epeolus* has been noticed by Linnæus as attaching itself to the beak of the flower of *Geranium Phæum*. The *Nomadæ* often choose as a place of rest the flower heads of various grasses; attaching themselves to one of these by the mandibles, they draw up their legs close to the sides of the body, fold their wings over the back, and extend their antennæ straight out in front. In this position they are in perfect harmony in form and colour with the flowers or seeds of grass, and very difficult to detect, even more so—allowing for their smaller size—than is the butterfly, *Thanaos tages*, when at rest in the same situation. With regard to this butterfly, it is solely from its habit of resting on grass heads and the blossoms of rushes that it sleeps on these with wings deflexed like a moth, whereby a more perfect concealment is

attained than would be possible if it kept its wings erect. And it is most interesting to note that specimens caught on dry hill-sides, where it rests on grass heads, are more variegated than those caught in marshy places where rushes abound, just as the blossoms of grasses are more variegated than the blossoms of the rush.

To return to the bees, the wasp-like colouration of many of the *Nomadæ* is worthy of consideration. The number of insects which mimic the *Vespidæ* is immense. Familiar instances are found in *Diptera*, *Coleoptera*, and *Lepidoptera*, and it is interesting that similar instances should occur amongst the stinging *Hymenoptera*. I think there are no more truly vespiform insects than these *Nomadæ*, and many of the Fossorial *Hymenoptera* are also exceedingly wasp-like.

One of the species of this genus was used by Mr. Poulton in his experiments (Proc. Soc. Zool., March, 1887) on the "Value of Colour and Markings in Insects," and he found it was untouched by any of the lizards to which it was offered. As the *Nomadæ* have the power of emitting an odour, which is no doubt protective, this should also be taken into account in the experiment.

The colours of the other species of the genus, which are chiefly brown and black, may also be warning ones, for they are very conspicuous when the insect is on the wing, but it is these species which are the most beautifully protected when at rest.

Here then is a genus the members of which are protected by a scent, by protective resemblance, by warning colours, and by a sting; but it is clear that insects so protected cannot often require to use that sting, and I feel sure that it is from this cause that of all our bees, or at least of those of equal size, the sting of the *Nomadæ* is the least painful. Even if they do succeed in piercing the skin, the pain is exceeding slight and lasts only for a minute or two. The Fossor *Philanthus*, too, which I have mentioned as provisioning its cells with bees, has a fierce wasp-like appearance; when handled it appears to make no attempt to sting. Many of the larger species of Crabro also, which I have often found carrying off large flies to their cells, look like large-headed wasps, and though I have occasionally handled them I do not remember ever being stung by them.

I must now pass on to another enemy by which *Andrena* is attacked, namely, the very curious genus *Stylops*; indeed these insects are so peculiar in structure that the late Mr. Kirby made for them a new order, which he called *Strepsiptera*. The fore wings or wing-cases of the male are

twisted and small, the hind ones broad, folding up like a fan, and the eyes are placed on a stalk. The female has neither eyes, mouth, nor legs, and, with the exception of the flattened thoracic portion which projects from between the terminal abdominal segments, is entirely concealed within the bee. Generally only one is present in a single bee, but sometimes two or even three may be found. The degeneration which this sex has undergone is, of course, due to the fact that it has no need to leave its host; but as the sexes are parasitic in separate hosts the male has naturally not degenerated to the same extent. All the species are very minute, and the males may be obtained by keeping Andrenas alive in captivity. They are seldom met with abroad. The *Strepsiptera* also attack *Halictus* and other genera of bees, and in other countries *Vespidæ*, *Homoptera*, and ants have been found stylopized. These insects are now generally considered as *Coleoptera*, and are placed near to the genus *Meloë*, which is parasitic on *Anthophora*, and which in its life-history rather resembles *Stylops*.

Stylops is ovoviviparous, and the larvæ are at first active hexapods. They crawl about on the hairs of the bee, and when it visits flowers they get on to these. Undoubtedly, enormous numbers of these larvæ, as also of *Meloë*, must perish, for they cling to and are carried off by any insect which may happen to visit the flower or to brush against the grass to which they cling. I have seen a specimen of *Nomada* so covered with the larvæ of *Meloë* as to be quite unable to fly.

When, however, the active *Stylops* larvæ have been transported to the burrow of the species on which they are parasitic (as happens to but a very small proportion of their number), they make their way into the larva of their host, and then undergo an *ecdysis* which entirely changes their form. They lose their organs of locomotion, and become cylindrical maggots, feeding in the interior of the larva. They reach the pupa stage when their host is on the point of emergence, and then bore through the body of the bee. One could hardly find a better instance of the entire dependence of the form of the larva on its mode of living, for we see in a single species the active form occurring at first when the insect has to go in search of food; then, when it is surrounded with all that it requires, it takes the maggot-like form which is always assumed under such circumstances.

(To be continued.)

FORAMINIFERA OF OBAN, SCOTLAND.

BY E. W. BURGESS.

(*Concluded from page 120.*)

44. *Lagena faba.* Balkwill and Millett, 1884.
Balkwill and Millett (G.), 1884, p. 13, pl. ii., fig. 10.
H. B. Brady, Syn. Rec. Brit. Foram., 1887. Jour. Roy. Mic. Soc., p. 905.
Mr. Brady observes; "I greatly doubt the wisdom of attempting to separate such specimens from *L. lævigata* and *L. marginata.*" Very common.

45. *Lagena quadrata.* Williamson, 1858.
Williamson (R. F.), 1858, p. 10, pl. i., fig. 27.
Balkwill and Millett (G.), 1884, p. 14. pl. iii., fig. 1.
Balkwill and Wright (I. F.), 1885, p. 341.
Wright, J., 1885-6. Proc. Belfast Nat. Field Club, p. 321, pl. xxvi., fig. 9.
Is it worth while, considering the variety of form, and also the depth and closeness of markings of *L. sulcata*, *semistriata* and *striata*, to separate such forms as these from *L. marginata*,—they seem to agree often both with *L. marginata* and *L. lævigata*? Rare.

46. *Lagena orbignyanà.* Seguenza, 1862.
Williamson (R. F.), p. 9, pl. i., figs. 19-20.
J. Wright, 1880-81. Proc. Bel. Nat. Field Club, p. 181, pl. viii., figs. 5, 5A.
Balkwill and Millett (G.), 1884, p. 14, pl. iii., fig. 1.
Balkwill and Wright (I. F.), 1885, p. 341.
A lagena which has a flattened, biconvex form, produced into a neck and three keels, the middle one being the largest. Rare.

47. *Lagena pulchella.* Brady, 1866.
H. B. Brady, 1866. Rep. Brit. Assoc. Nott., Trans., p. 70.
H. B. Brady, 1870. Ann. and Mag. Nat. Hist., Ser. 4, Vol. vi., p. 294, pl. xii., figs. 1A-B.
Balkwill and Millett (G.), 1884, p. 14, pl. ii., fig. 13.
Robertson, D. (W. S.), rare.
Differing from *L. clathrata* by the costæ branching; a variation of *L. orbignyana.* The specimens from Oban, 1888, are very fine and typical. Rare.

48. *Nodosaria pyrula.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 17, pl. ii., fig. 39.
Balkwill and Wright (I. F.), 1885, p. 343, pl. xii., fig. 23.
Robertson, D. (W. S.), 1874, rare.
An elongated variety, with inflated segments, usually smooth, the ends of which are long, narrow tubes. Rare.

49. *Nodosaria scalaris.* Batsch, 1791.
Williamson (R. F.), 1858, p. 15, pl. ii., figs. 36-8.
Robertson, D. (W. S.), 1874, common.
The chambers vary in number, the costæ also, both in number and in the fineness or coarseness of markings; mostly two-chambered. Frequent.

50. *Nodosaria communis.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 18, pl. ii., figs. 40-1.
Robertson, D. (W. S.), from six places.
Oban, 1883. Rare.

51. *Vaginulina legumen.* Linne, 1758.
Williamson (R. F.), 1858, p. 21, pl. ii., fig. 45.
Robertson, D. (W. S.), 1874, rare.
A nearly straight pod-like form, not spiral (fragments only). Rare.

52. *Cristellaria rotulata.* Lamark. 1804.
Williamson (R. F.), p. 27, pl. ii., figs. 52-3.
Robertson, D. (W. S.), 1874, frequent.
Oban, 1883. Rare.

53. *Polymorphina gibba.* D'Orbigny, 1826.
Balkwill and Wright (I. F.), 1885, p. 345.
Robertson, D. (W. S.), 1874, enumerates *P. lactea* frequent, and *P. gibba*, common.
H. B. Brady, Syn. Rec. Brit. For., 1887; Jour. Roy. Mic. Soc., London, p. 912.
"Scarcely separable either in character from *P. lactea.*" Rare.

54. *Uvigerina angulosa.* Williamson, 1858.
Williamson (R. F.), 1858, p. 67, pl. v., fig. 140.
A triangular species, tapering towards each end; aperture with a lip like a bottle; surface costate. Frequent.

55. *Globigerina bulloides.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 56, pl. v., figs. 116-8.
Robertson, D. (W. S.), 1874, rare.
The best known form of all Foraminifera. Rare.

56. *Globigerina rubra.* D'Orbigny, 1839.
Wright, J., 1886, Fauna S.W. Coast, Ireland, p. 613, Proc. Roy. Irish Acad. Ser. 2, Vol. iv. (Science.) Rare.

57. *Orbulina universa.* D'Orbigny, 1839.
Williamson (R. F.), 1858, p. 2, pl. i., fig. 4.
Robertson, D. (W. S.), 1874, common.
H. B. Brady, 1870, Ann. and Mag. Nat. Hist., p. 277, p. 298.
Generally spoken of as rare in shallow water, and such specimens are often of a brown colour, likely to be cast aside as not foraminiferous. Rare.

58. *Patellina corrugata.* Williamson, 1858.
Williamson (R. F.), 1858, p. 46, pl. iii., figs. 86-9.
Robertson, D. (W. S.), 1874, rare.
J. D. Siddall, 1886, Liv. Mar. Biol. Com. Report, p. 70, frequent.
A form that at present cannot be mistaken for any other shell, generally frequenting muddy bottoms. Rather rare.

59. *Discorbina globularis.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 53, pl. iv., figs. 104-5.
Robertson, D. (W. S.), 1874, common.
Of a very hyaline texture, strongly perforated, the later segments increase very rapidly in size, the last three or four being half the shell. Common.

60. *Discorbina rosacea.* D'Orbigny, 1826.
Williamson (R. F.), 1858, p. 54, pl. iv., figs. 109-11.
Robertson, D. (W. S.), 1874, common.
A trochoid shell, of varying height, with three or four coils, each of which contains about four segments, which are convexed, edged, and describe about one-third of a circle, mammillated on the edge, otherwise they might be mistaken for *Rotalia nitida.*
These mammillated edged *D. rosacea*, I think, ought to be called *D. rosacea* var. *mamilla*, Will., as there seems quite as much variety between D'Orbigny's specimens and Williamson's as between *Lagena lævis* and *striata.* Very common.

61. *Rotalia Beccarii.* Linne, 1767.
Williamson (R. F.), p. 48, pl. iv., figs. 90-2.
Robertson, D. (W. S.), 1874, common.
Many of these (Oban, 1888) are very young shells, not incrusted with lime, and therefore in beautiful condition. Common.

62. *Rotalia nitida*. Williamson, 1858.
Williamson (R. F.), 1858, p. 54, pl. iv., figs. 106-8.
Robertson, D. (W. S.), 1874, rare.
A trochoid shell, smooth, few convolutions, segments trapezoidal, very transparent, often of a reddish colour. Frequent.

63. *Nonionina depressula*. Walker and Jacob, 1798.
Williamson (R. F.), p. 97, pl. iii., figs. 70-1.
Robertson, D. (W. S.), 1874, common.
Oban (1888). Common.

64. *Nonionina turgida*. Williamson, 1858.
Williamson (R. F.), 1858, p. 50, pl. iv., figs. 95-7.
Robertson, D. (W. S.), 1874, common.
Oban (1888). These are very fine; the final segment is often half the size of the shell. Common.

65 *Polystomella crispa*. Linne, 1767.
Williamson (R. F.), 1858, p. 40, pl. iii., figs. 78-80.
Robertson, D. (W. S.), 1874, common.
Of this species, it will be noticed that there are few without the spines at the circumference, in connection with which read Prof. Williamson's remarks. Perhaps one of the most beautiful, and one of the most abundant forms in many gatherings. Very common.

66. *Polystomella striato-punctata*. Fichtel and Moll., 1803.
Williamson (R. F.), 1858, p. 42, pl. iii., figs. 81-2-2A.
Robertson, D. (W. S.), 1874, common.
Oban (1888). Common.

67. *Operculina ammonoides*. Gronovius, 1781.
Williamson (R. F.), 1858, p. 35, pl. iii., figs. 74-5.
Common.

PROFESSOR POYNTING ON OUR PHYSICAL BELIEFS.

I have read with much pleasure the able and interesting paper by Professor Poynting on the "Foundations of our Belief in the Indestructibility of Matter," read before the Birmingham Natural History Society, but do not think the matter is yet disposed of.

In dealing with ultimate ideas, and in fact in all reasoning, we take for our premises an assumption that cannot be proved by reason of its generality, but the negation of which is inconceivable. Every step of the argument we base upon

these premises we test in like manner, for if the negation be conceivable, the argument is invalid and falls to the ground. It is mainly over this question of conceivability and inconceivability the noise of the strife is heard.

A student of philosophy, carefully watching every step of his argument and checking it by this method, may be interrupted and disconcerted by someone saying, "But the negation of your assumption, which you say is inconceivable, *I* can conceive with ease." What is the student to do? The process is entirely a subjective one, and there is a possibility of his being wrong. If any defect of mind exists which prevents a clear comprehension of the matter, this defect may as easily be present in the student as in the mind of his critic, and who is to deliver judgment?

Thus Professor Poynting says: "The expansion of a continuous solid is unlike anything else, and is therefore inexplicable, but I hold—and here I think Mr. Spencer would consider me quite hopeless—that there is no difficulty in conceiving of the expansion of continuous matter." Here is an apparent deadlock of the kind just described, but when examined it will be seen that a conception of this character does not hold when stated in plain terms. For Coke says that he could conceive a world in which two and two do not make four, and, extraordinary as this sounds, it is, I venture to suggest, an exactly parallel case, and equally valid with the "expansion of a continuous solid." The latter is verbally intelligible, but has it any deeper meaning? Is it not, in fact, one of those illegitimate symbolic conceptions which Mr. Spencer defines as "such that no cumulative or indirect processes of thought can enable us to ascertain that there are corresponding actualities, nor any predictions be made that can prove them?"

Professor Poynting also contends that, while Mr. Spencer holds that the Indestructibility of Matter and the Continuity of Motion are necessary truths, he thinks it conceivable that they are false. For instance, of course, we can never be certain that we are right. Our conclusions are arrived at and tested by the only instrument at our disposal, our consciousness (upon the validity of which we stake all), and may not correspond in the remotest degree with actual realities and absolute truths; but, though the professor avers he can conceive these great doctrines false, surely he cannot conceive their opposites. We *may* be wrong in saying that matter is indestructible, but can he render into thought its destructibility, or can he form a conception of the annihilation of motion, or, in other words, of something becoming nothing?

I imagine that the bone of contention is the question whether physical truths can be known *a priori* or not? That the Professor takes the latter view is evident from his closing sentence which runs thus: "In fact I suspect that the mind is provided only with machinery ready to arrange the results put into it by the senses, and that it does not contain any results ready made."

Contrary as this is to all metaphysical doctrines by what school soever held, it does not concern us here; all that is desired is to prove it erroneous in its application to physics.

Mr. Spencer, when replying to the "Quarterly Review" which attacked him on this point, October, 1878, so thoroughly threshed out the matter that nothing I could possibly add (even were I so presumptuous) could do otherwise than weaken my case. Mr. Spencer took as his premises a quotation from his critic's chief authority (Thomson and Tait). It was as follows: "Physical axioms are axiomatic to those only who have sufficient knowledge of the action of physical causes to enable them to see at once their necessity." What do we understand by an axiom? Clearly an *a priori* truth. If not, by what process of experiment do you proceed to prove an axiom such as that expressed by the words, "Things that are equal to the same are equal to one another?" It cannot be done, as at every step of the proof it is taken for granted; presuming that physical axioms partake of the same character as those of mathematics. Again the phrase, "To see at once their necessity," also excludes the *a posteriori* view.

Mr. Spencer says: "Though Newton gives illustrations of prolonged motion in bodies that are little resisted, he gives no *proof* that a body in motion will continue moving if uninterfered with, in the same direction at the same velocity." "Does Professor Tait deny that the first law of motion is a physical truth, and denying that it is established *a posteriori*—that is, by conscious induction from observation and experiment? If so, what is the inductive reasoning which can establish it?"

I should like to refer to the opinion of another physicist, Professor Tilden. The practice of pitting authority against authority is often objectionable, but the point he refers to in this connection is of sufficient interest to excuse it. Speaking of the Molecular Hypothesis, and comparing it with the theory of Gravitation, he says: "We possess at present no direct or positive proof even that molecules exist, still less have we any evidence regarding the conditions under which they may subsist in mass . . . . *In neither case does the theory admit of direct experimental proof*; but both are

accepted because they accord fully with the result of observation." If, then, experiment is unable to prove a truth, it follows that the truth is not experimentally derived. As in chemistry, so in astronomy all the fundamental truths which are accepted as valid and from which deductions are made are *a priori*. If this be denied then (to quote Mr. Spencer), "Show us an astronomical experiment."

H. S.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, M.A., AND J. E. BAGNALL, A.L.S.

(Continued from Vol. XI., page 291.)

198. **Ag. mycenoides,** *Fr.* Rare. Oct. Ansty; Combe, *Adams.*

Sub-genus XX.—Inocybe.

199. **Ag. lanuginosus,** *Bull.* Woods and parks. Oct. In Lord Aylesford's park at Packington! *With.*, 228. Plantations at Arrow; Oversley Wood, *Purt.*, iii., 213.
200. **Ag. scaber,** *Müll.* Shady woods. Rare. Oct.-Feb. Oversley and Ragley Woods, *Purt.*, iii., 205. Dale House Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.*
201. **Ag. lacerus,** *Fr.* Woods. Rare. Oct. Burton Green Wood, Kenilworth, *Russell, Illustr.*
202. **Ag. flocculosus,** *Berk.* Amongst grass. Rare. Kenilworth? *Russell, List.*
203. **Ag. Bongardii,** *Weinm.* Very rare. Oct. Amongst grass, Edgbaston Park.
204. **Ag. obscurus,** *Pers.* Rare. Sept. Lodge Wood, Warwick, *Perceval.*
205. **Ag. hæmactus,** *B. and C.* Very rare. Sept. Church Lane, Ansty, *Adams!*
206. **Ag. fastigiatus.** *Schæff.* Woods. Rare. Sept. Crackley Wood, Kenilworth, 1868, *Russell, Illustr.*
207. **Ag. rimosus,** *Bull.* Woods and pastures. Not rare. Aug.-Oct. Pastures, Edgbaston, *With.*, 199. Oversley Hill, *Purt.*, ii., 635. Ragley Park! *Purt.*, iii., 406. Warwick, *Perceval.* Kenilworth, *Russell, Illustr.* Ansty, *Adams.* Cawstone, *Rugby Sch. Rep.* Edgbaston Park; New Park, Middleton; Trickley Coppice; Sutton Park; Four Oaks Park; Coleshill Pool; Coleshill Heath; Shawberry Wood; Packington Park; Olton Reservoir; Waverley Wood, Stoneleigh; Alveston Pastures, etc.

208. **Ag. asterosporus,** *Quel.* Woods. Sept.-Oct. Trickley Coppice; New Park, Middleton; Coleshill Pool; Bradnock's Hayes; Sutton Park. No doubt overlooked for *Ag. rimosus.*
209. **Ag. eutheles,** *B. and Br.* Under fir trees. Sept. Red Rock Plantation, Edgbaston (*Ag. cacuminatus*). *With.*, 198. The Spring and Crackley Wood, Kenilworth, *Russell, Illustr.* Corley; Lady Adams' Garden, Ansty, *Adams.*
210. **Ag. descissus,** *Fr.*, var. *auricomus, Batsch.* Woods. Rare. Roots of filbert trees, Edgbaston, *With.*, 289. Kenilworth, Sept., 1849, *Russell, Illustr.* Ansty, *Adams.*
211. **Ag. sindonius,** *Fr.* Shady places. Rare. Oct. Red Lane, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.*
212. **Ag. geophyllus** *Sow.* On the ground in woods. Not frequent. Aug.-Oct. Oversley Wood, *Purt.*, iii., 686. Warwick, *Perceval.* Crackley Wood and the Dale, Kenilworth, *Russell, Illustr.* Combe Wood, *Adams.* Coleshill Pool; Trickley Coppice.
213. **Ag. trechisporus,** *Berk.* In woods, amongst ferns. Rare. Oct. Combe Woods, *Adams.* Alveston Pastures.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

BY W. B. GROVE, M.A.

(Continued from page 109.)

There are several other ways in which the cultivation of Bacteria on a solid stratum can be conducted, besides that previously described. In the first place, if the number of germs in our first plate cultivation is so numerous that the colonies soon become confluent with one another, it is easy to make a second attenuation by taking a small portion of the first and mixing it with a further large quantity of liquefied nutrient gelatine. All that is necessary for success is to thin out the individuals sufficiently and protect the plates of glass from the air. Moreover, if an accidental germ from the air should fall upon the plate, it remains and grows exactly where it falls, and can easily be recognised as a stranger.

But when we have attained a pure stock, it is easier to continue the cultivation in a test tube about six inches long; the lower third of this is filled with nutrient gelatine, and the

mouth closed with a plug of cotton wool; the whole is then sterilised by steaming. A small portion of the material to be observed is transferred by a platinum needle, previously heated in a flame, to the surface of the gelatine in the tube, which (since the material is solid) can be held upside down during the operation. The plug of wool is then restored, and the tube kept at the appropriate temperature in an incubator. If all the precautions are duly observed, the result will be a characteristic and easily watched growth in the gelatine at the bottom of the tube.

Well boiled potatoes, cut in halves with a sterilised scalpel, also furnish a suitable medium for growing certain kinds, and, if they are kept under glass covers, accidental contamination may be avoided. The hands, the glass covers, and everything else which comes near, but is not in actual contact with, the cultivated material, can be washed with corrosive sublimate solution to kill any germs that may be upon them.

It is by the adoption of equally careful precautions that successful results have been attained in the cultivation of the Uredineæ (Leaf-Fungi). In both cases it was seen long ago that nothing but such certainty of cultivation would ever enable us to come to correct conclusions upon the biology and the species limitation of these particular groups, but in both cases, when the desire first manifested itself, it seemed hopeless of realisation. The fact that such success has been reached in the propagation of Fungi in these two groups should confirm our hopes that similar success awaits the ingenuity of some one in regard to other groups, where similar knowledge would be equally invaluable. It is somewhat strange that the greatest certainty of "pure" cultivations should have been attained in the treatment of the most minute Fungi, in which *a priori* one would have expected the greatest difficulty.

One of the points of interest in connection with the Bacteria, which has aroused very considerable warmth of argument, is the question of their pleomorphism, as it is termed, that is, their capacity for assuming at different stages of their growth different morphological characters, so different in fact that they would be set down, if independently observed, as distinct and even widely distinct species.

It is obvious that the method of "pure" cultivations affords a means of settling this formerly vexed question in a satisfactory manner. Many such series of experiments have been performed, and the ultimate result has been to confirm the opinion I have always expressed, that this pleomorphism is

not characteristic of all the Bacteria. Certain species and genera are extensively pleomorphic; to quote the words of an observer, about *Bacterium laminariæ*: "At a given moment, in a pure cultivation, elements of all sizes and forms are to be seen, some like Leptothrix, Bacillus, and Bacterium, others like Vibrio, and others like Spirillum." But, on the other hand, certain genera and species are, so far as the evidence goes at present, absolutely unchangeable and constant in form.

This question has been frequently and warmly debated, but is now set at rest to an extent which would have been quite impossible but for Koch's method of solid media. Whatever care was exercised with a *liquid* nutrient solution, the objection that foreign germs had been introduced during the process could never be entirely controverted.

Distribution of Bacteria.

But, perhaps, it will occur to some that there is one difficulty which nothing that has yet been said will enable us to surmount. In all our manipulations, the things that are used, after being sterilised, must be exposed to the air, and we have been taught that the atmosphere is full of the germs of Fungi. How then are we to prevent these germs from entering and contaminating everything? We might, it is true, perform all our operations under a disinfecting spray; it would be difficult, but not absolutely impossible. Obviously, before we can tell what is our best course, we must carefully investigate the truth of the common belief in the abundance of germs in the atmosphere, and the method of plate cultivation offers exactly the means required for so doing.

If a plate, prepared as before, but without any sowing of Bacteria, be exposed to the air in a certain place for a certain time, every germ which falls upon it will remain where it falls; and then, if the plate be kept at a suitable temperature, every one which is capable of growing under these conditions will develop and produce its colony. These colonies can then be counted, and by that means some idea may be formed of the number of Bacteria in the air of any given place. In this way and others the question has been investigated by several persons, notably by a Frenchman, Miquel, and interesting results have been obtained.

Miquel directed a measured current of air to the surface of a gelatine plate, and counted the germs thus entrapped. He found that a cubic metre of air in the Park at Montsouris contained between ... ... 30 and 700

In the same bulk from the Rue de Rivoli there were 5,500

From the Hall of St. Christopher 6,300
From the Ward of an Hospital 11,000
But of these only one in ten was alive and capable of development; the rest were dead.

This is at the surface of the earth, not far above sea-level. The higher we go the fewer the Bacteria become; and at an elevation of about 7,000 feet they have entirely disappeared. No Bacterium or Fungus spore of any kind was detected at that height. On the surface of glaciers, too, they are nearly absent. The number found in any given locality varies, of course, with circumstances. Immediately after rain, the air, which has been, so to speak, *washed*, contains fewer than at other times. They also vary with the seasons. In the same park at Montsouris, Miquel found 49 per cubic metre in the winter, 85 in the spring, 105 in the summer, and 142 or even more in the autumn. This has been confirmed by Frankland, and thus the common belief in the greater impurity and unhealthiness of the atmosphere in the latter season has been justified. It is easy also to see why it should be so, for autumn is the season when the greatest amount of vegetable putrefaction is going on, and when the opportunities for the increase of putrefactive Bacteria are the greatest.

But there is another consideration which influences more effectively the number of Bacteria present in the air of an enclosed space, and that is the presence or absence of atmospheric currents. Even the smallest germ has weight, and in perfectly still air will fall to the ground. It is found that if the manipulation of the sterilised gelatine takes place in a room where the air is in motion, or where the fallen Bacteria have recently been disturbed by sweeping or dusting, contamination is inevitable, but if all doors and windows be securely fastened, and all the movements be performed quickly, but steadily, then no contamination arises unless the number of germs in the room is enormously great. As an instance of the latter, Dr. Klein records that, after a large number of experiments had been performed in his laboratory with *Bacillus anthracis*, the air became so full of the spores of that species that they introduced themselves unbidden into every cultivation.

Dr. Frankland showed how the quantity of floating Bacteria present can be measured by the number which falls upon a square foot of horizontal surface per minute. The average at Kensington was 279 per square foot; but on a cold windy day 433 fell per minute. In the country 79 fell per minute; in Hyde Park 85. In enclosed spaces, such as rooms, the number was much smaller, but the effect of agitation of

the air was more marked; thus, in a quiet room, 44 fell per minute; but when twenty people were dancing in it the number was increased to 400; and in a third-class carriage on the Underground Railway, containing ten people, it rose to the enormous number of 8,120. It is stated that, during a conversazione of the Royal Society, each cubic metre of the air of the library has contained 48,200 bacterial germs.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 91.)

LEES, IN "BOTANY OF THE MALVERN HILLS."

* **G. rotundifolium**, 33. (In the 2nd and 3rd Editions this species is queried. Mr. Lees adds, "Uncommon, and I feel somewhat uncertain of its locality.")

* **G. columbinum**, 33. Ill.

* **Erodium moschatum**, 33. On Lumbertree Bank, Welland Common. (Mr. Lees adds, in the 3rd Edition, "I fear lost by enclosure of the waste.")

* **E. maritimum**, 33. At the eastern base of the North Hill, before the path turns to the Ivy-scar Rock. Plentiful there in 1841. (Mr. Lees adds, in the 2nd and 3rd Editions, "Since obliterated at this spot." "On the northern bank of the Common at Barnard's Green." Ill. *Still growing on North Hill; R. F. Towndrow, 1888. Sp.!*

* **Euonymus europæus**, 18. Ill.

† **Ulex minor**, 34. Lees. *This is identified in the 3rd Edition with the true Ulex nanus of Forster. Probably an error for Ulex Gallii.*

* **Genista anglica**, 34. On Welland Common.

* **Anthyllis vulneraria**, 35. Mostly confined to calcareous strata, where, as at the Croft Limeworks, it is abundant. It also grows at Castle Morton on red marl. Ill.

* **Medicago sativa**, 35.

M. lupulina, 36.

M. maculata, 36. This has been gathered at Hawford, near Worcester, by my friend Mr. Abraham Edmunds, junr. *But in the 2nd and 3rd Editions we read:* Abundant in a grassy path in Mr. Smith's large hop yard at Wick, not far from the Severn, where my friend Mr. Thomas Baxter, of the College School, pointed it out to my notice.

* **Melilotus officinalis**, 37.

Trifolium pratense, 36.

* **T. medium**, 36.
* **T. arvense**, 36. Ill.
* **T. striatum**, 36.
* **T. repens**, 36.
* **T. fragiferum**, 36. Side of the road to Welland. Ill.

T. procumbens, 36.

T. minus, 36.

* **T. filiforme**, 36.
* **Astragalus glycyphyllus**, 36. Woody hills. W. Ill.
* **Ornithopus perpusillus**, 36. Ill.
* **Onobrychis sativa**, 36. Western side of Brock Hill. (*In 3rd Edition.* Croft quarries at Mathon. Gadbury banks at Eldersfield.) Ill.

Ervum hirsutum, 36.

E. tetraspermum, 37.

* **Vicia sylvatica**, 35. In the coppices of most of the calcareous heights on the western side of the hills. Ill.
* **V. lathyroides**, 35. On the hills, small. *Queried in 2nd and 3rd Editions.* Ill.
* **V. bithynica**, 35. On the borders of a large field below the Admiral Benbow, Malvern Wells. On the borders of cornfields at Broadwas; Miss H. Moseley. Ill.
* **Lathyrus Nissolia**, 35. On the edge of the wood near the Croft Limeworks, Mathon. Also about Madresfield. Ill.
* **L. sylvestris**, 35. Near Pendock, Portway. Ill.

L. palustris, 35. Only in a marshy meadow on the western side of Longdon Marsh.

Orobus tuberosus, 35.

* **Prunus insititia**, 23. In hedges about Barnard's Green and Welland Common. Ill. *Perhaps Prunus communis var. fruticosus is intended here.*

P. austera (*P. Cerasus, L.*). Hedges, Barnard's Green. Rare.

* **Spiræa Filipendula**, 24. On the Old Hills. Ill.

Potentilla Fragariastrum.

* **P. verna.** On the rocks of the hills.

P. reptans.

P. anserina.

* **P. argentea.**

Tormentilla officinalis.

* **T. reptans** (*Potentilla procumbens*).

Fragaria vesca.

* **Rubus Idæus**, 27. Ill.

R. nitidus, 27. (*R. Lindleianus*, 2nd Edit. 57, 3rd Edit. 73.)

R. affinis, 27.

* **R. rhamnifolius**, 27. (*R. cordifolius*, 2nd Edit. 57, 3rd Edit. 74.)

R. discolor, 27.

R. fruticosus, 27. (*R. argenteus*, 2nd Edit. 56, 3rd Edit. 73. *Probably the same as R. discolor. See Babington, "British Rubi," p. 160.*)

* **R. leucostachys**, 27.

R. carpinifolius, 27.

R. villicaulis, 27.

R. pallidus, 27. *Prof. Babington refers this to R. Hystrix. See "British Rubi," p. 173. Mr. Lees's plant is not the R. pallidus of the Rubi germanici.*

R. rudis, 27.

R. Radula, 27.

* **R. Koehleri**, 27.

R. echinatus, 27. *A form of the last. See 3rd Edit., p. 70, Babington's "British Rubi," p. 209.*

‡ **R. fuscus**, 27. (*Professor Babington refers this to Rubus glandulosus, var. hirtus; "British Rubi," p. 250. The localities are in Herefordshire; see 2nd Edit., p. 52; 3rd Edit., p. 69.*)

R. fusco-ater, 27.

R. diversifolius, 27. *Not in the 2nd or 3rd Editions.*

R. dumetorum, 27. *This I believe to be R. diversifolius of modern authors.*

R. corylifolius, 27.

R. Schleicheri, 27. *This is R. tenui-armatus of the 2nd and 3rd Editions, and is referred by Prof. Babington to R. Balfourianus. See "British Rubi," p. 255.*

R. cæsius, 27.

* **Rosa spinosissima**, 24. Ill.

* **R. Doniana**, 24. Ill.

* **R. villosa** (*mollissima*), 24. Ill.

* **R. tomentosa**, 25. Ill.

‡ **R. scabriuscula**, 24. Cowley Park and Cradley. *A variety of the preceding. A Hereford record.*

R. inodora, 25. In bushy pastures below Malvern Wells, eastward. *In the 1st Edition Mr. Lees states that this is the R. Borreri of Woods; but in the 3rd, 64, he describes it as R. tomentella, Leman. Both are now considered varieties of R. canina.*

(To be continued.) p 160

Wayside Notes.

THE HISPID NATURE OF THE YOUNG OF PALUDINA VIVIPARA.—I have been re-reading the very interesting valedictory address by Mr. Wm. Jeffrey to the Conchological Society on the "Nature and Development

of the Hairs or Bristles on some Land and Fresh-Water Shells," printed on pp. 17-25 of the fifth volume of "The Journal of Conchology," and in a note at the end he says: "The young of *Paludina vivipara* and *Planorbis corneus* are also said to be hispid, but these hairs are probably of a very delicate nature, and do not seem to be retained in cabinet specimens." I cannot speak of the latter species, as I have had no opportunity of examining its young in the fresh state since my attention was directed to the note. But of the former species I can positively speak, and in a confirmatory manner. I have some specimens of *Paludina vivipara* alive in confinement, which I took the other day in company with Mr. F. R. Fitzgerald from the "Bathing Pond" on Hampstead Heath, London, N., where this species abounds in almost countless numbers. Thinking these to be pregnant, I rapidly killed two by immersion in a cold saturated solution of oxalic acid, and broke up the shell with a pair of dissecting forceps, cut through the thick columellar muscle, and extracted the animal. On following up the oviduct under water with the needle, in one of the specimens I found two embryos (4 mill. long) bulging out the walls of the oviducal lumen. There were others, but these were the largest, and I carefully extracted them. An examination of the shell-sculpture in these embryos with a lens showed strongly marked carinations (using this word in the sense given by G. W. Tryon in the first volume of his "Structural and Systematic Conchology"), which were even throughout their whole extent with the exception of one at the periphery of the body-whorl and two above it. These, under a low power, appeared to be of a granulate character, as if the ribs had been broken up at regular intervals. On using, however, the three glasses together of my pocket lens I saw that each of these granules was tipped with a little horny-whitish hair, a condition of things which resembles strongly the appearance presented by the knob and its attached cilium, which Engelmann has described on the free surface of the columnar cells in the enteric canal of some molluscs. I may add that the hairs were easily detached by the finger, leaving the granules behind, and that I can offer no explanation of their occurrence unless they may be regarded as a reversion to an ancestral condition, or, at least, explicable by the "fundamental biological law" of Ernst Haeckel.—J. W. WILLIAMS.

NOTTINGHAMSHIRE SHELLS: A CORRECTION.—In a note on p. 94 *ante*, I described *Balea perversa* (Linn.) as not hitherto recorded for Nottinghamshire. This I stated on the authority of Messrs. Taylor and Roebuck, who, in their recently revised "Census of the Authenticated Distribution of British Land and Fresh-water Mollusca," published at the end of my little book, "Land and Fresh-water Shells," do not give this species for the county under note. However, looking over some back numbers of "The Naturalist," I find that on p. 213 of the volume for 1886, there is a note by Mr. W. A. Gain, who records taking it, in company with Mr. Musson, "beneath the loose bark of willow trees growing near the junction and within each of the parishes of Darlton, East Markham, and East Drayton." My friend, Mr. G. W. Mellors, of Nottingham, however, called on me last evening, and he tells me that in Mr. Musson's manuscript list of Nottinghamshire shells which he possesses, it is not so recorded, and that Mr. Musson was exceedingly strict in transmitting all his "finds" to paper. At any rate, though perhaps not as I stated new to Nottinghamshire, the two localities I recorded are evidently new. I take the present opportunity of placing upon record other shells

which Mr. Mellors has sent me from Nottingham. The most interesting are *Helix rotundata* (Müll.), and its var. *Turtonii.* (Flem.), *H. aculeata* (Müll.), *Hyalinia fulva* (Müll.), *H. crystallina* (Müll.), from Kirkby; *Helix virgata* (Da Costa), and its var. *subalbida* (Poiret), from a lane between Staunton and Long Pennington; *Ancylus fluviatilis* (Müll.), from Kirkby; *Helix ericetorum* (Müll.), and its var. *alba* (Charp.), from Alverton; *Cæcilianella acicula* (Müll.), from Tollerton; *Helix caperata* (Mont.), from Staunton; *Paludina contecta* (Mill.), from Newark; and *Bythinia Leachii* (Shepp.), from near Trent.—J. W. WILLIAMS.

LEAFING OF OAK AND ASH.—These trees were considerably earlier in the unfolding of their leaves than they were in 1888, and the relative difference in time was also much more pronounced than in that year. During the week from May 18th to the 25th, the oak trees were becoming well clothed in leaves, so that by the latter date there was scarcely a tree to be seen without a full head of foliage. The ash trees were markedly behind, and there were only a few trees that had fully developed their leaves by the 23rd, and these only in favourable situations. In making these observations attention was paid both to the habit of individual trees, and especially to the kind of station. For example, the valley of Luton has slopes on the opposite sides, with eastern and western aspects. On the hill facing the west, there were *young* ash trees that had leaves fairly developed by the 17th or 18th, and were as much advanced as oak trees on the opposite hill top with a northern aspect. But the tall ash trees on this side showed scarcely a sign of leaf, while the oak trees growing near them had their foliage half expanded. It was not till the 23rd to 25th of May that the ash trees with a northern aspect made any marked advance in their foliation, whilst not a few of them were almost bare. In fact, when allowing the eye to range over a near landscape, one could detect the presence of almost every ash tree by its bareness of leaves, which was particularly marked on the 25th. It should be stated that these observations were limited to South Beds, and a portion of the county of Herts adjoining.—J. SAUNDERS, Luton.

PLANTS IN FLOWER IN MAY.—I beg to submit a list of wild flowers, which, in the week ending 12th inst., came under my notice in North Devonshire, in the neighbourhood of Ilfracombe, Bideford, and Clovelly:—Silene maritima, Lychnis (pink variety), Ground Ivy, Geranium, Bellis perennis, some fields white therewith; Primrose, Violet, Oxalis, Orchis, Garlic, Periwinkle, Black Thorn, Stitchwort (greater and lesser), Cardamine pratensis, Vetch, Dandelion, Hyacinth, Gorse, in luxuriant flower over acres of ground at a time; Anemone, Broom, Marsh Marigold, Greater Celandine, Strawberry, Dog's mercury, Cotyledon umbilicus, Lousewort, Plantain, Milkwort, Chickweed, Groundsel, Mustard Charlock, Lords and Ladies, Raywort (on walls), Ling (on summit of Gallantry Bower, Clovelly), Cowslip, Ranunculus (? species), Germander Speedwell, Water Cress, Trefoil, Spurge, Weasel Snout, Yellow Cow Wheat, Tormentilla, Comfrey, a flower very like "London Pride," Geum (avens), Lamium purpureum, Butcher's Broom, Scarlet pimpernel, Lamium album, Shepherd's purse, Sonchus arvensis (sow thistle!), Ranunculus aquaticus. There was a very pretty creeper beginning to flower, frequently to be seen on roadside walls, the name of which I do not know. [*Linaria cymbalaria*, doubtless.—Ed. "M. N."]—CHARLES COCHRANE, Pedmore, near Stourbridge, May 15, 1889.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION, April 11th. Mr. W. R. Hughes, F.L.S., in the chair. The president reported that he had written to Sir Philip Magnus in reference to the establishment of a Spencer Society in London, suggesting that he should co-operate with Miss Naden for this purpose, and that he had received a reply from him. Also that he had met Sir Philip Magnus at Miss Naden's house where the matter had been discussed. Also that he had had the pleasure of a brief interview with Mr. Spencer at the Athenæum Club, and was pleased to say that his health had undergone improvement. In consequence of small attendance, it was decided to postpone Mr. Buncher's paper to May 9th.—May 9th. Mr. W. R. Hughes, F.L.S., in the chair. The president announced that he had received a further communication from Sir Philip Magnus, informing him that Mr. Clodd would probably join the London Society. Mr. Stone exhibited an autograph letter from Charles Darwin to Asa Grey, containing a very characteristic passage. Mr. Harold Buncher read his paper on "Segregation," an exposition of the twenty-first chapter of Herbert Spencer's "First Principles." An interesting discussion followed.—GEOLOGICAL SECTION, April 16th. Mr. W. B. Grove. M.A., chairman. Mr. Wilkinson exhibited (1) *Lecidea pulchella*, a very rare lichen from the top of Ben Nevis, (2) fine collection of foreign ferns. Mr. Marshall read a paper on "The Gulf Stream and its Effect upon the Climate of England and Norway." An interesting discussion followed, and vote of thanks to Mr. Marshall.—GENERAL MEETING, April 30th. The President in the chair; 90 present. Mr. G. C. Druce, F.L.S., of Oxford, gave his "Notes on a Recent Tour through Spain," illustrated by a very interesting series of lantern photographs, which were exhibited by Mr. C. Pumphrey; including fine views of the principal cities of Spain, and the cathedrals and palaces, and also of Gibraltar, and finishing with the frontier town of San Sebastian, where the recent meeting of the Queens of England and Spain took place. A very interesting description was given of the country and buildings, and especially of the extensive flora of Spain, which includes a large number of rare and endemic species. The lecture was much enjoyed by those present. —MICROSCOPICAL SECTION, Tuesday, May 7th. The President in the chair; 115 present. The Rev. T. Simcox Lea, M.A., of Sapey Bridge, near Worcester, gave a lecture on "Oceanic Islands, from a Collector's Notes," illustrated by lantern photographs of the Sandwich Islands, New Zealand, Fernando de Noronha, &c., and also of Australia, which were exhibited by Mr. C. Pumphrey. These oceanic islands are remote from the great continents, and it was shown that they are distinguished by distinct floras and faunas; Australia has to be included among the number, containing many remarkable genera, especially Eucalyptus, which numbers sixty species. The Sandwich Islands have an extensive native flora, but foreign plants, including many common tropical weeds, have been imported, and have established themselves so firmly that they are encroaching upon and taking the place of the native plants, which are thus being gradually extinguished; the same change is taking place in other oceanic islands. The island of Fernando de Noronha, off the coast of Brazil, is a special example of a native flora

being thus destroyed. This island was visited by Mr. Lea, as a volunteer naturalist, in company with an expedition sent out to make collections for the British Museum. He gave some graphic illustrations of life on the island, which is used as a convict settlement. The temperature, he said, varied only between 78° and 82° throughout the year. Mr. Pumphrey afterwards exhibited a series of lantern photographs, including a number of beautiful illustrations of hoar-frost on trees and shrubs, which he took last winter.—BIOLOGICAL SECTION, May 14th. Mr. C. Pumphrey in the chair. Mr. W. B. Grove, M.A., exhibited *Cornuvia metallica*, a beautiful myxomycete new to the district; also, for Miss Gingell, *Auricularia mesenterica*, *Peziza Adæ*, and the æcidial stage of *Triphragmium ulmariæ*, from Dursley; Mr. J. E. Bagnall showed *Orchis mascula*, *Scilla nutans flore-albo*, and other flowering plants and mosses, from Dursley. An interesting paper by Mr. J. B. Stone, J.P., entitled "Plant Marches, or the Geological Progression of Plant Life," was read, in the absence of the author, by Mr. Herbert Stone. A short discussion followed in which Messrs. Pumphrey, H. Stone, Bagnall, Grove, and T. Clarke took part.—GEOLOGICAL SECTION, May 21st. Mr. Waller, B.A., B.Sc., in the chair. Mr. W. P. Marshall exhibited Spider orchis, from Wye Common in Kent; Mr. Grove, various fungi; Mr. Thomas Bolton, some elvers, sent by Mr. Cullis, from Gloucester. Mr. Grazebrook, of Dudley, read a note, communicated by Mr. E. Pritchard through Mr. W. R. Hughes, on "Gold-bearing Quartz of South Africa." Some fine specimens of the rock were exhibited, including conglomerates, quartzites, and volcanic ash. Mr. Goode exhibited samples of crushed gold-bearing rock, from Victoria, Australia, said to yield :—(*a*) 18ozs. 15dwts. to the cwt., (*b*) 11ozs. 4dwts. to the cwt. An interesting discussion followed, and a cordial vote of thanks to Mr. Grazebrook. A communication was read from the British Association on the subject of Geological Photography.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 29th. Mr. H. Hawkes reported on the excursion of the members to Weymouth, and read lists of the flowering plants and seaweeds observed, and afterwards shown at the meeting. Mr. J. Madison exhibited specimens of *Helix cereolus* and *H. Carpenteriana*, from the United States; Mr. Camm, the following Fungi :—*Dothidea ulmi*, *Lachnella nivea*, *Reticularia lycoperdon*, and *Cornuvia metallica*; Mr. Hawkes, a series of marine algæ, with reproductive organs. Mr. G. H. Corbet then read a paper on the "Diffusion of Iron." The writer said he did not purpose speaking of its diffusion in organic nature, but rather of its geological distribution. The various rock systems from the Laurentian to the Chalk were reviewed, with the amount of iron they contained and the forms in which it occurred. The Carboniferous system was particularly rich in this mineral, twenty-five kinds of ironstone being found in our local coalfields. Magnetite, ilmenite, limonite, chalybite, marcasite, hematite, and specular iron ore were described at some length, with the quantity of iron they yielded. This metal, so generally distributed, had been called the "pigment of nature," and, considered with our coal supply, had largely contributed to our national greatness. A collection of the various ores, &c., was shown at the meeting.—May 6th. Mr. J. Collins exhibited a named and mounted collection of marine algæ, from Weymouth; Mr. J. Moore, specimens of *Helix nemoralis*, with an umbilicus; also specimens of *Cyclostoma elegans* var. *ochroleuca*, from Portland; Mr. J. Madison, *Helix Newberryana* and *H. californiensis*,

from the United States. Under the microscopes, Mr. Moore, odontophore of *Cyclostoma elegans*; Mr. Collins, Spirogyra in conjugation.—May 13th. Mr. J. W. Neville showed pensile cocoons (probably of a lepidopterous insect) formed of pieces of stick and covered with silk, from Buenos Ayres; also an albino specimen of house sparrow, from Handsworth, where it came regularly to be fed until its death; Mr. Hawkes, *Uromyces scillarum* and *Œcidium epilobii*. Mr. C. P. Neville then read a paper on "The Life History of a Butterfly." The various stages in the development of the egg, larva, pupa, and imago were described, and the variety presented in the forms of eggs and larvæ was spoken of as very interesting. The "unerring instinct" of the female, always depositing her eggs on the right food plant, was questioned from personal observations. The paper, which also dealt with the development of colour and form with each successive moult, was illustrated by lantern pictures.

OXFORDSHIRE NATURAL HISTORY SOCIETY. — April 30th. The President, Mr. E. B. Poulton, M.A., in the chair; present, about forty-eight members. Five new members were proposed. The Rev. Bedford Pim gave a paper on the "Hydroquinone Process in Photography," illustrated by some of the results of his work. Mr. J. O. Sankey lectured on "Pallas's Sand Grouse," giving an interesting account of this curious bird. Mr. Geo. Harris showed a nest of the Procession Caterpillar, from Arcachon near the Pyrenees, and also briefly described its habits; and Mr. Poulton showed a curious Sphinx Caterpillar, from Africa.—May 14th. The President, Mr. E. B. Poulton, M.A., F.R.S., was in the chair, and forty-two members were present. Five new members were elected and one proposed. Dr. W. Collier gave a lecture on the "Comparative Sensitiveness to Pain of Animals." He was of opinion that animals felt less pain than man, and he founded his belief on the following facts and inferences:—(1) Pain, though felt at the part affected, was produced in the brain, and pain sensations were conducted by nerves more or less specialised for the purpose. Hence, knowing what we do about the brain, it was reasonable to infer that a brain of low development would feel less pain than a highly organised one. (2) It is known that some men feel pain much less than others. These are men of strong muscular development, and of little intellectual power—such as an agricultural labourer. Dr. Collier related several dentists' stories concerning the agricultural labourer, showing how little he felt the pain of tooth-drawing. Savage races, also, were known not to feel pain so acutely as we do. Proceeding to animals such as horses and dogs, various tales were told showing surprising indifference to what seemed very painful injuries. The lecturer also showed how the sudden shock of a severe wound paralysed the nerves at first, so that no pain was felt at the time when the wound was inflicted. He then proceeded to the case of the lower animals, and said it was extremely doubtful if they had any pain-conducting nerves at all, and when injured they showed but little sense of pain. Hence, taking these two arguments together—simplicity of nervous organisation in animals and few signs of pain when injured—he thought that we might safely conclude that their sensitiveness to pain is less than ours, although, of course, the higher animals suffered more than the lower, and all would suffer to some extent. But this comfortable belief, said Dr. Collier in conclusion, by no means excused any cruelty to animals. A discussion followed, and various speakers told tales more or less corroborating the lecturer's theory.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

We are glad to report that a very cordial invitation has been given by the Oxford Natural History Society to hold the Annual Meeting of the Midland Union in that city in the Autumn, and that the Executive Committee of the Union, at the suggestion of the Oxford Society, has fixed Monday and Tuesday, September 23rd and 24th, for the Meeting. These days are in the week immediately following the Meeting of the British Association, at Newcastle (September 11-19), and will, therefore, suit those who wish to attend the great *omnium gatherum* of scientific men and others.

The Union is to be heartily congratulated upon this invitation from the youngest society in its ranks, and we hope that everything will be done to make the Meeting the success it deserves to be. On the part of the host-society, we are assured that no efforts will be spared, and the attractions of Oxford are so great and varied, that the Meeting ought to be one of the largest in the history of the Union.

WILD BEES.

BY R. C. L. PERKINS,

JESUS COLLEGE, OXFORD.

(Concluded from page 129.)

OSMIA.

Of this genus we have only ten British species, but their habits are varied and interesting, and it will be necessary to take the different species more or less apart instead of speaking of the group as a whole. They have a ventral pollen-brush, and their mandibles are exceedingly powerful, so that some of the species can readily burrow into hard wood.

The habits of many of the species vary under different conditions: *Osmia rufa* for instance, a very abundant species, may often be found forming its burrows in an old tree or post, at other times in the mortar of walls, or in the ground; or it will make use of any ready-made suitable cavity, an old lock for instance, or a hollow stone, and fill them with its cells. It may very properly be included amongst the so called "Mason bees," for it very frequently constructs its cells of

clay in a cavity between the stones or bricks of a wall; it may be seen building in this manner in the Botanical Gardens, any fine day in spring or early summer.

Another species *O. pilicornis* which is a scarce bee, very partial to the flowers of the Purple Bugle, I have found making its nest in hard stony ground, but also in a detached piece of dead wood lying on the surface of the soil. *O. parietina* which frequents hilly or mountainous districts in the more Northern counties, seeks out a stone which encloses a cavity beneath it, and attaches its cells to the under surface of this. The two species *O. fulviventris* and *aenea* generally burrow in posts or rails, but are always willing to make use of the holes which have been made by nails in the mortar of walls. The former bee I have often watched cutting roughly oval pieces from the leaves of rose trees, selecting not the green ones, but those which are yellow and decayed: it leaves a ragged outline very different from the neat work of the leaf cutting bees: and I believe it does not use pieces of leaf of any size, but bites them up to form a kind of cement, with which it separates the adjoining cells.

It cannot be doubted that the exquisite leaf-building of the true leaf-cutters (*Megachile*) arose from some simple habit like this, and we can well imagine the next step to have been the employment of the oval piece entire, as a separation between the cells—a saving both of time and labour—and finally the employment of leaf for all parts of the *nidus*.

Two other species, *Osmia aurulenta* and *O. bicolor*, will burrow in the ground when the soil is suitable, but they often save themselves this labour by making use of empty snail shells, in which they construct their cells, separating them by transverse partitions and finally closing the opening of the shell. But the latter species (*O. bicolor*) is not content with this security, for although the snail shells chosen are generally already well concealed by their position, it uses other means to render that concealment more perfect. Where this bee is plentiful,—and it is usually abundant where it is found at all—you may often catch specimens carrying in their mandibles pieces of dry grass-stalks of considerable length. Grasping these at the middle, they fly off with them to their *nidus*, and arrange them over the shell somewhat in the shape of a dome. The labour of the bee in cutting the number required and bringing them home—often from a considerable distance—must be very great. I have lately heard from Mr. Harwood that he has detected another species, *O. spinulosa*, making its nest in snail shells. I have not found the *nidus* of this species myself.

There is still one species to be noticed, *O. leucomelana*. It is a very local bee and hardly ever abundant, but I have met with it in South Devon, and also with the *nidus*. This is constructed in a dead bramble stem: having found a dry stem of suitable size, it has only to remove the pith to form an excellent burrow. In this it makes several cells, placing in each the usual little pollen mass, and forming partitions between them.

Other British bees make use of bramble stems, *Prosopis* and *Ceratina* for example, and so do large numbers of the Fossorial Hymenoptera, and one cannot but wonder that a still larger number of bees have not thus saved themselves the labour of excavating harder materials.

The genus *Stelis* is parasitic on *Osmia*; we have but three British species of these parasites, all of which are rare or very rare. Not much is known of their habits beyond the fact that like other parasites they enter the burrows of the *Osmia* during her absence and deposit their egg. I have met with two of the species. One wet day I found a female of *Stelis phæoptera* in one of the unoccupied burrows of a colony of the Fossor, *Crabro cephalotes*, which would indicate that like other parasitic bees I have mentioned they do not venture to sleep in the burrow of their host.

In connection with this genus may be noticed the brilliantly-coloured parasitic *Chrysididæ* or Ruby wasps, for the *Osmiæ* are the most liable of our bees to be attacked by them. They are, however, very general in their attacks, the Fossorial section being especially subject to them. Entering the burrows of the industrial bee they deposit their eggs, but, as one would guess from the fact of some species attacking either bees or the carnivorous Fossors, it is not on the food which is stored up that they prey, but on the larvæ of their hosts.

Perhaps the most noteworthy fact in the habits of the Ruby wasps is the special means of protection they have acquired. To save themselves from the sting of the host, on whose young they prey, they roll themselves up into a ball, so that no weak spot in their armour remains open to attack, and many species do attack them with the greatest fury. The Fossor, *Bembex*, is notorious in this respect. A curious fact is told of an assault made by one of the leaf-cutter bees on one of these *Chrysididæ*; on its return it caught the parasite, and, finding it protected in all other parts, bit off its wings, and let it drop to the ground from its burrow, which was constructed in a wall. Nevertheless, when the bee had flown off for a fresh supply of pollen, the parasite crawled up the

wall, and deposited its egg in the cell from which it had been dislodged.

BOMBUS.

The social bees of this genus, commonly called humble bees, are so well known to every one that it is needless to say much about them. Besides the males and female their nests contain a third form, the workers or neuters. On the first warm days in the spring the females of the Bombi may be seen abroad after their hibernation. Each one of these is by herself the foundress of a nest. She chooses a suitable spot above ground, if a surface builder, or some ready-made cavity, such as an old mouse hole, if an underground species, and here unassisted she collects a mass of pollen, and forms a few honey-pots. in which is contained honey enough to keep the larval food sufficiently moist. From the eggs first laid there hatch out workers, which at once aid her in enlarging the nest, and gathering food for the increasing brood. Later on eggs are laid from which males and females are subsequently developed, but these are less in number than the workers.

In the autumn the bees forsake their nest, the females alone surviving the winter. These hibernate beneath the bark of trees or under moss, or bury themselves beneath the soil, and may then be frequently met with when you are searching for Lepidopterous pupæ. At this time they are often almost entirely covered with *Acari*, which remain on them throughout their existence, and from this cause they are sometimes quite unable to fly, and may be seen crawling about helplessly on the ground.

Their nest, with its irregularly placed cells and small piece of comb, and the neat covering of moss or grass by which it is so well concealed, has been described again and again in books, and may be seen on almost any mossy bank and in every hayfield. No bees are liable to the attacks of so many enemies as these, for besides mice, which frequent similar situations, and spoil their nests, birds devour them in immense numbers. Very commonly you may find under the lime trees, sycamores, or horse-chestnuts, when in blossom, many dead specimens of these bees, and many still crawling about although partly eaten. This is the work of tits and other insectivorous birds, which form little bands of from six to a dozen individuals, and having devoured the contents of the body let the remainder fall to the ground. Of the *Lepidoptera*, the *Galleria* is a terrible enemy, its larvæ infesting the nests in such numbers that the young are deserted by the bees.

The Dipterous genus, *Volucella*, preys on their larvæ, and from its abundance must be very destructive. These flies, in

their colours and general appearance, closely resemble the species on which they are parasitic, and so are enabled to enter the nest, and deposit their eggs with greater safety. But, besides these flies, they have other parasites in the extraordinary genus *Conops*, several species of which are usually abundant.

Of bees, the genus *Psithyrus* (=*Apathus*) is parasitic on the bumble bees. In general appearance they closely resemble Bombi, but of course they have no workers, and no pollinigerous apparatus. The females hibernate and deposit their eggs in the spring and early summer, when the Bombi have begun to provide for their larvæ, and amongst these they are developed.

And here, in conclusion, it will be appropriate to say something about parasitic bees in general. Clearly parasites belong to two distinct classes: (i.) those which are nearly related to their hosts, and (ii.) those which are totally dissimilar.

Of the first class the most striking instance is found in these *Psithyri*. There cannot be the faintest doubt that they are degenerate forms of Bombi which, through parasitic habits, have lost their means of collecting pollen and their workers. But other parasites belong to this class which do not *at first sight* resemble their hosts; such are *Melecta* and *Anthophora*, *Megachile* and *Coelioxys*, *Osmia* and *Stelis*. For it is highly probable that the differences between these parasitic genera and their hosts have merely been brought about by their parasitism. Take *Melecta* and *Anthophora*, for instance, what is more likely than that some ancestral species of the latter formed large colonies as *Anthophora pilipes* and others now do, and that some individual took to depositing its eggs in its neighbours' burrows, instead of collecting its own pollen, and that this was continued from generation to generation. Naturally the loss of pollinigerous apparatus would follow (and in a social bee the loss of the worker as well), and other changes would take place in the parasite best suited for the accomplishment of its purpose. I should rather wonder myself if this had not sometimes happened. I have seen a female of the Fossor, *Agenia** *variegata*, which preys on spiders, enter the burrow of another female, probably either to rob or dispossess it, as a furious fight ensued; and I have seen two females of *Pompilus gibbus* fight for a spider which one of them had captured. I have

* Cf. M. Fabre's observations on *Tachytes*; also a Fossor, mentioned by Darwin ("Origin of Species," p. 216).

said above that though *Psithyrus* is so like its host, in the other cases I have mentioned there is not the same obvious resemblance.

Yet from an examination of various structures which one would expect to be the least changed by the parasitic habit, and from the similarity in these between host and parasite, I have not the least doubt that their case is the same as that of *Psithyrus*. I will here quote two passages which support this. Shuckard, in his "British Bees," p. 49, says: "*Melecta* resembles *Anthophora*, *Cœlioxys* has the form of *Megachile*, both in the hollow base of the abdomen and the peculiar manner the latter has of raising its extremity—something like a *Staphylinus*. Many other peculiarities of resemblance might be ennunciated." The other is from a paper by Mr. Edward Saunders "On the Terminal Segments of Aculeate *Hymenoptera*" (published in Trans. Ent. Soc., March, 1884), where he says: "Still it is worthy of note that there is often an extraordinary general similarity in the apical segments of the parasites and of the bees with whom they live: *Megachile*, and *Cœlioxys*, *Chalicodoma* and *Dioxys*, *Anthophora* and *Melecta*, are striking instances of this similarity." With regard to the other class I can say little. *Nomada* is an obvious instance. Whether they were originally parasites of forms allied to themselves, or whether from the first they attacked bees totally different in appearance and structure to themselves, I have found no means of deciding. Though now chiefly attacking *Andrena*, it is quite possible that they were not originally parasitic on these bees, since even now we know of two species which attack the *Apidæ* or long-tongued bees, of the genera *Eucera* and *Panurgus*.

Epeolus, however, which equally with *Nomada*, has no affinity with its host, appears to restrict its attacks entirely to *Colletes*.

NOTE ON A GRANITE CONTAINING LITHIA.*

BY MR. T. H. WALLER, B.A., B.SC.

Some time ago I had a sample of rock sent to me by a friend with a request that I would determine the amount of soda and potash contained in it. Following the method of analysis which is, I believe, most generally in use, I obtained a mass of

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alkaline chlorides, which I proceeded to weigh. It was immediately obvious, however, that the mass was gaining weight somewhat rapidly, showing the presence of some deliquescent salt. An attempted purification left matters as they were before, and made the absence of calcium or magnesium chloride in any appreciable quantity quite certain. The point of a fine platinum wire was then dipped in the somewhat deliquesced salt, and when this was held in the flame of a Bunsen burner the momentary vivid red flame showed the presence of lithium chloride, which was at once abundantly confirmed, on repeating the experiment, by observing the flame through a pocket spectroscope. On separating the lithium chloride by Gooch's method of using boiling amyl alcohol, the chlorides of potassium and sodium were quite normal in behaviour in the air, being only quite slightly hygroscopic under the then existing conditions of the atmosphere as to moisture and temperature. In this way the lithia in the rock was found to amount to as much as 0·7 per cent. Further specimens were obtained through the kindness of Messrs. Watts, Blake, Bearne and Co., the owners of the Meldon Quarry, near Okehampton, from which the rock was procured, and I have been able to make a more thorough examination of the chemical and microscopical characters of this peculiar granite.

The full analysis gives the following results:—

Silica	72·4
Lime	0·9
Manganese Oxide	0·2
Magnesia	0·2
Alumina	16·0
Ferric Oxide	1·0
Soda	4·6
Potash	3·0
Lithia	0·7
Loss on ignition	0·9
	99·9

In this analysis the amount of oxide of manganese is higher than is usual in bulk analyses of rocks. Attention was at once called to it by the bright green colour of the melt when decomposing by fusion with alkaline carbonates. It occurs apparently as the colouring substance of the tourmaline and possibly in part in the mica.

The comparative quantities of potash and soda will also be noticed; even if the lithia be regarded as replacing potash, there is not such a preponderance as is usual in granites.

The rock is mentioned by Mr. Teall, in his "British Petrography." He says (p. 316): "A remarkable variety of granite occurs at Meldon, near Okehampton. It is almost a pure white, somewhat resembling statuary marble in appearance, and is composed essentially of quartz, felspar (largely plagioclase), white mica, and topaz. Black mica is absent; the rock is therefore a Muscovite granite. It contains also green tourmaline." In a note he speaks of the topaz as occurring in grains which but rarely show good form in thin sections, but gives reasons which make the identification certain.

The constituents of the specimens which I have had the opportunity of examining are, on the whole, of medium size. The dimensions of the separate grains of quartz and felspar, are about the same in all directions, and on an average from $\frac{1}{25}$ to $\frac{1}{16}$ of an inch across—some of the felspars being, however, somewhat elongated. Occasional veins of larger crystals traverse the mass, in which the aggregation of the various minerals is much looser than in the more close grained parts, so that it has not been possible to make sections. As the constituents do not seem to vary in kind, this is not of so much importance, and the easy separation of the mica makes it a simple matter to determine the fact that the lithia occurs in this mineral and not in the felspar. In these veins, too, the tourmaline occurs in fairly large crystals of a beautiful pale-green colour, or sometimes of a very delicate pink. The two colours are often present in the same crystal, the one forming a core, the other surrounding it. The crystals were of sufficient size to permit of the determination of the angle over the edges of the terminal rhomb by means of the reflecting goniometer, and fragments give the blowpipe reaction for boric acid with the utmost distinctness. On examination of a thin slice, we find that almost all the felspar is of one of the triclinic varieties. In such sections as show a symmetrical extinction with regard to the plane of twin composition, the extinction angle is generally low. I have seen no case in which the presence of labradorite or any more basic felspar could be determined, and indeed the very small amount of lime, as found by analysis (0·9%), makes the presence of such impossible.

The question naturally arises as to how the alkalies are distributed, whether both in one felspar or in two separate felspars, such as orthoclase and albite; or, finally, whether most of the potash is present in the mica. The very great preponderance

of the triclinic felspar makes the latter suggestion the more likely, or rather there does not seem enough felspar which has not the multiple twinning to account for the amount of potash present. On separating the constituents as accurately as possible by means of Sonstadt's solution, I could get no satisfactory distinction between the various fractions within the limits of the specific gravities of the felspars. A great many grains, tested by Szabo's flame reactions, showed the preponderance of soda in the felspar, but not such an absence of potash or such a fusibility as would have been expected in the case of albite; and in a few of the cases where the extinction angles could be satisfactorily determined the occurrence of angles of about 40° between the extinctions of the two sets of twin lamellæ makes it more probable that at any rate some of the felspar is oligoclase. Still there was apparently another maximum extinction at about 30°—32° which would best suit albite, and the amount of lime compared with the soda, even allowing that some of this was contained in the mica, seems too low to allow of oligoclase being the chief basic felspar.

In a paper on the Lithia Micas of New England, by F. W. Clarke, in the Bulletin of the U.S. Geol. Survey, abstracted in the Chemical News, June 3, 1887, the author speaks of the chief localities as situated along a belt of albite granite, and furnishing in almost all cases tourmaline of green and pink colours as an accompanying mineral.

The quartz is chiefly noticeable on account of the very few so-called fluid cavities contained in it. Inclusions are common, but they are either flakes and needles of some mineral or minerals which I have not been able to identify, or else ill-defined cloudy masses giving a rather dirty appearance to the quartz. These also occur in the felspar, and in both cases are often heaped in the central parts of a grain, or are gathered into zones, following more or less closely the outline of the grain. In among the larger constituents is found in some parts, indeed pretty generally, a rather irregularly intergrown micropegmatite, or sometimes it has more the look of the finely interlocked grains of quartz which are so common in some of the schistose rocks.

The mica occurs in pearly-white flakes; those which form part of the mass of the rock very often show but slight cleavage, and have a very slightly pink colour. Fragments held in the flame of the Bunsen burner give the intense carmine colour due to lithia, and it is in this mineral only that the alkali occurs, the felspar, so far as I have seen, giving no trace of it.

Of the accessory minerals the tourmaline has been already mentioned. Occasional patches have the dark blue colour of indicolite, others are very pale green, almost colourless in thin section.

Topaz occurs sparingly and somewhat irregularly, and the grains very rarely show any trace of their crystalline form, and even cleavage cracks are not frequent. Here, again, I have found only very few and very minute fluid cavities, none large enough for any observation as to whether the liquid is carbonic acid or not.

I have also been fortunate enough to get hold of specimens of the junction of the granite with the surrounding slate. In these, as is usual, the junction is perfectly sharp; the size of the crystalline grains of the intrusive rock is hardly perceptibly different up to a small distance varying from $\frac{1}{8}$ to $\frac{1}{16}$ of an inch from the slate, then follows a zone of quartz and felspar of much smaller dimensions, with a few larger crystals, then a very narrow zone of about $\frac{1}{100}$ inch, consisting apparently of the same minerals in grains of about the same size as those in the previous zone, but the felspars contain fewer inclusions, so that the effect is of an almost perfectly clear line. Then follows, suddenly, the slate, here changed into a schist crowded with tourmaline crystals, the ground being made up of a fine mosaic of quartz. It is a curious circumstance that specimens of this schist, taken from within an inch of the junction, show the presence of lithia when tested in the blowpipe or Bunsen burner flame, whereas those at a greater distance show no trace of it. This is possibly due to the development in the schist of a few flakes of a white mica, which, in places, forms veins which look as if they had been originally cracks in the rock. The tourmaline shows only a moderate dichroism, pale yellow when parallel to the shorter diagonal of the polarising nicols prism, brownish yellow when at right angles to it. The crystals frequently show traces of the terminal planes, and are simply crowded with enclosures of some indeterminable mineral; they occasionally have spots of a blue colour in the paler mass in the manner so common in the mineral.

A few grains of a highly refracting substance, which appears to be isotropic, I should refer to a pale garnet, but they show no crystal outlines which would guide one, and are quite small. Another specimen of a pale brownish-white rock, which occurs near the granite, is a hornstone, but I have no knowledge as to the exact relation in space between it and the eruptive rock.

The occurrence of tourmaline is very frequent among the granites of Devon and Cornwall, and topaz occurs occasionally, as at St. Michael's Mount, and both minerals are constantly associated with tin stone. The presence of fluorine in these minerals has suggested to some geologists that they are secondary formations, and that it is possible that the gaseous agent in the production of them was the fluoride of tin which is easily volatilised, and is also easily decomposed by the action of water affording oxide of tin for the tin stone, and hydrofluoric acid, which would be able to effect further changes in the rocks. Fluorine is also a constituent of lepidolite, so that the association of minerals is quite a natural one.

The presence of lepidolite among the constituents of the Cornish granites was mentioned by Mr. Allport, in his paper on the rocks surrounding the granite masses of the Land's End (Q. J. G. S., 1876), and I have mentioned to this Section the very widespread diffusion of lithia among granitic micas from all parts of the kingdom, but I have not come across any other except one Scotch muscovite which contained sufficient to at once colour a flame so as to be visible without a spectroscope.

In this connection it is interesting to recall the occurrence of a very large percentage of lithium chloride, viz., 26 grains to the gallon, in a spring in Clifford United Mines, in Cornwall, as mentioned by Dr. Miller.

It is obvious that such a rock as we have before us this evening, on being subjected to those influences which result in the kaolinising of the felspars, and the alteration at the same time of the mica, would be very likely to furnish a spring water with a large amount of lithia.

The spectroscopic means at my command did not enable me to examine the mica for the still rarer alkalies, rubidia and cæsia. They occur in some of the lepidolites of Maine in rather considerable quantity; indeed, I believe, the quantity contained in some (2·44% of rubidia, and 0·72% of cæsia) is larger than in any other known substance, except the mineral pollux, which contains 32 % of cæsia. A thorough examination of the alkalies on a large scale would be of great interest.

It will be obvious that this paper is very imperfect, and it seems worth while to recall the opinion of Professor Judd, that the microscopical study of rocks, even when combined with the chemical study of them, should be subordinated to the geological or field examination, and not take the place of it. In this case it is plain that the question as to the

relations of this particular mass to the ordinary granite of Dartmoor, which at Okehampton is very close, would be very interesting. Is this merely a local variety of the main mass, or is it a separate intrusion ? Rutley mentions andalusite as developed in the slates near Okehampton at the contact with the granite of Dartmoor. Are the alteration products constant in the two cases, or is the development of either the tourmaline or the andalusite more or less, so to speak, accidental? To these questions I can unfortunately not pretend to offer any answer, and it would need detailed examination in the field, and then careful examination of the specimens to approach the matter with any hope of success.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 143.)

LEES, IN "BOTANY OF THE MALVERN HILLS."

* **Rubus rubiginosa**, 25. Ill.

* **R. micrantha**, 25. Ill.

* **R. sepium**, 25. *A doubtful record. See note, 3rd Edit., 63.*

R. canina, varieties of—

canina (*lutetiana*), 26.

‡ **sarmentacea** (*dumalis*), 25. Cowleigh Park (*Hereford*).

‡ **glaucophylla**, 26. Between Cowleigh and Cradley (*Hereford*).

surculosa, 26. On the side of a lane leading from Welland Common to Castle Morton and Longdon.

* **dumetorum**, 26. Ill.

* **Fosteri** (*urbica*), 26.

* **R. systyla**, 26. In the copse at the back of the Wells House; in a hedge between Little Malvern Priory Farm and Welland Common; and at Powick.

* **R. arvensis.**

* **Pyrus torminalis**, 23. Not uncommon. Ill.

* **P. Aucuparia**, 23.

* **P. communis**, 23. Ill.

* **P. Malus**, 23. Ill.

* **Lythrum Salicaria**, 23. Sides of water.

* **Peplis Portula**, 21. Welland Common.

* **Epilobium angustifolium**, 21. On the northern border of Welland Common.

E. hirsutum, 21.

E. montanum, 21.

* **E. roseum**, 21.

* **E. tetragonum**, 21.

* **E. palustre**, 21.

* **Myriophyllum verticillatum**, 40. In the Teme.

* **M. spicatum**, 40. *See "Midland Naturalist," Vol. XI., p. 306, as possibly in Worcester.*

* **Hippuris vulgaris**, 13. Abundant in Longdon Marshes, near Castle Morton.

Callitriche verna, 40. *Probably C. platycarpa.*

C. autumnalis, 40. In some deep ditches between Barnard's Green and the road to Madresfield. *Probably C. pedunculata. See 2nd Edit., p. 73; 3rd Edit., p. 95.*

* **Bryonia dioica**, 40.

* **Sedum Telephium**, 22. On the Ivyscar and other rocks of the North Hill. Ill.

* **S. album**, 22. On the rocks of the North Hill, but very seldom flowering. Ill.

* **S. acre**, 22.

* **S. reflexum**, 22. Ill.

* **Cotyledon Umbilicus**, 22. In crevices of the rocks. Ill.

* **Saxifraga granulata**, 22. End Hill. Ill.

* **S. tridactylites**, 22. Little Malvern. Ill.

* **Apium graveolens**, 19. In ditches at Longdon Marsh and Pendock Portway. Ill.

* **Helosciadium inundatum**, 19. Only in deep stagnant water holes by the brook on Welland Common. Ill.

* **Petroselinum segetum**, 19. On a marly headland extending eastward from Castle Morton Church. Very local.

* **Sison Amomum**, 19. In shady lanes.

Ægopodium Podagraria, 19.

Bunium flexuosum, 19. Pastures.

* **Sium angustifolium**, 19. Rare. Ill.

* **Bupleurum tenuissimum**, 19. Plentiful on the common by the road side, just beyond Garford Court, Barnard's Green, where it was first indicated to me by William Addison, Esq. Ill.

* **Œnanthe fistulosa**, 19. E.

* **Œ. pimpinelloides**, 19. E. Rare. Abundant in many dry fields about Forthampton. Ill.

Œ. peucedanifolia (*silaifolia*), 19. On the borders of Longdon Marsh also in a ditch by the lane between Castle Morton and Longdon Marsh.

* **Œ. crocata**, 19. About springs and ditches in the fields and coppices near the Chalybeate Spa.

* **Œ. Phellandrium, 20.** In stagnant pools about the Chace. Ill.

Æthusa Cynapium, 20.

Heracleum Sphondylium, 20.

Daucus Carota, 20.

Torilis Anthriscus, 20.

Anthriscus vulgaris, 20.

* **A. sylvestris, 20.**

Chærophyllum temulum, 20.

Scandix Pecten-Veneris, 20.

* **Smyrnium Olusatrum, 20.** Red marl; E.; scarce.

Hedera Helix, 18. Covering the Ivyscar Rock most luxuriantly. On Little Malvern Priory, &c.

* **Cornus sanguinea, 15.** Plentiful.

* **Viscum album, 41.** Parasitical on the Apple, Pear, Hawthorn, Maple, Lime, Ash, Willow, Mountain Ash, White Poplar, Black Poplar, Aspen, Robinia pseud-acacia, Elm, Hazel, and Oak.

* **Sambucus Ebulus, 20.** By the side of a lane connecting Birts Morton with the Ledbury Road. Also in a hedge by the road side at Wick, between Powick's Bridge and Boughton's Nursery.

* **Viburnum Lantana, 20.** W. Ill.

Lonicera Periclymenum, 18.

L. Xylosteum, 18. On the eastern side of Longdon Marsh, and at Powick.

Galium erectum, 15. Near Alfrick.

G. tricorne, 15. In corn fields at the Croft, Mathon.

Valerianella olitoria, 14.

* **V. dentata, 14.**

And var. **mixta, 14.** By the side of the road between New Pool and Hanley Turnpike Gate below the Wells.

* **Dipsacus sylvestris, 15.**

* **D. pilosus, 15.** Below the Abbey, Great Malvern. Most abundant in a lane between the Church and the Priory Farm at Little Malvern. Ill.

* **Onopordum Acanthium, 38.** Near Welland Church.

* **Silybum Marianum, 38.** Ill.

* **Carduus nutans, 38.**

* **C. acanthoides, 38.**

Cnicus lanceolatus, 38.

* **C. pratensis, 38.** Longdon Marsh. Ill.

* **C. acaulis, 38.** On the commons at the eastern base of the hills. Ill.

Arctium Lappa, 38. (*A. majus.*)

A. Bardana, 38. (*Probably A. minus.*)

* [illegible] 206

* **Serratula tinctoria, 38.** Woods. Ill.

Centaurea Cyanus, 39.

* **Chrysanthemum segetum, 39.**

C. Leucanthemum, 39.

* **Matricaria Parthenium, 39.**

M. inodora, 39.

* **M. Chamomilla, 39.** Ill.

Anthemis Cotula, 39.

* **A. arvensis, 39.** Fields about the Berrow, plentiful.

* **A. nobilis, 39.** Abundant on Barnard's Green and Welland Common. Ill.

* **Artemisia Absinthium, 38.** Ill.

A. vulgaris, 38.

Gnaphalium germanicum, 38. (*Filago germanica.*)

* **G. minimum, 38.** (*F. minima.*)

G. uliginosum, 38.

* **G. sylvaticum, 38.** On the End Hill, most abundantly in 1841. Also by the side of the road near North Cottage, Malvern Wells. Ill.

Senecio vulgaris, 39.

* **S. sylvaticus, 39.** Abundant.

* **S. squalidus, 39.** On old buttresses near "Betty's Boat," the Priory Ferry, Worcester.

S. erucifolius, 39.

S. Jacobæa, 39.

S. aquaticus, 39. Longdon Marsh.

† **S. erraticus, 39.** New Pool, Malvern Chace. Omitted in 3rd Edit. *It is doubtful what was intended by this name. If S. erraticus of Bertoloni, it is not British.*

* **Bidens cernua, 38.**

B. tripartita, 38.

* **Conyza squarrosa, 39.** (*Inula Conyza.*) Base of Ragged Stone Hill, The Croft, &c.

* **Pulicaria dysenterica, 39.** (*Inula dysenterica.*)

Pulicaria vulgaris, 39. (*Inula Pulicaria.*) In watery spots on Barnard's Green, &c.

* **Erigeron acris, 39.** On old walls at Leigh, on the northern side of the Churchyard.

Tussilago Farfara, 39.

* **Eupatorium cannabinum, 38.**

* **Cichorium Intybus, 38.** Castle Morton.

Lapsana communis, 38.

(To be continued.) p 152

TWO HITHERTO UNDESCRIBED VARIETIES OF LIMNÆA STAGNALIS (LINN.)

BY JOSEPH W. WILLIAMS.

AUTHOR OF "THE SHELL-COLLECTOR'S HANDBOOK FOR THE FIELD," "LAND AND FRESH-WATER SHELLS," ETC.

I do not hold with giving special variety-names to colour-variations in the shells of land and fresh-water Mollusca, neither do I hold with defining as var. *major*, *maxima*, *minor*, or *minima* shells which differ only from the type-form in largeness or littleness respectively. The colour of the former class can be as well expressed in our native tongue, and the size of the latter can be far better given in terms of measurement. For example, it is as well to say a white *Helix nemoralis* as to say *Helix nemoralis* var. *albescens* (Moq.), and it serves the scientific purpose better to give the height of a form in measurement than to describe it as var. *major*, or var. *minor*, which may be anything above or below a certain set number of millimetres. I have stated my views on variety-naming in a series of four papers to "*Science Gossip*," on "Variation in the Mollusca and its Probable Cause,"—the first part of which, the editor writes me, will appear in the July number,—and to these papers I must refer the reader for an extension of these my views on variety-naming. But I consider, on the other hand, that when a form is found *differing from the type by a combination of structural characters of shell*, it is as well that a special variety name be appended to it. To this class of varieties the two forms of shell of *Limnæa stagnalis* I am now going to describe are to be relegated. I propose to give to them the special variety-names of *elegans* and *contortula*.

Variety *elegans*.—Height, 35 mill.; breadth of body-whorl, 15 mill. Whitish in colour; aperture small, rounded, inner lip ("parietal wall" of Pfeiffer) well pronounced; spire elongated, suture deeper than in type, subscalariform, in general run of spire somewhat like that of the marine shell *Turritella replicata* (Linn.); body-whorl not babylonic, shorter than in type ($\frac{3}{7}$ total length of shell) and revolving more evenly; suture between the body-whorl and the whorl immediately preceding it deeply and triangularly canaliculate. Locality.—Pond in field off Platt's Lane, Hampstead, London. Given to the describer by Mr. G. K. Gude, by whom it was collected.

Variety *contortula.*—Length, 24 mill.; breadth of body-whorl, 9 mill. Shell small, narrow, thin, fragile, light horn-coloured; aperture ($\frac{3}{8}$ total length of shell), same shape as in type; body-whorl and the preceding whorl rounded and not babylonic; the fourth and fifth whorls equal in size and markedly gibbous all round; suture of the spire markedly deep, but the suture between the body-whorl and the whorl immediately preceding it no deeper than in type; spire subscalarid. Locality.—Pond in field at East Finchley, London. Collected by the describer.

The pond in which I found what I have called var. *contortula* is thick with aquatic plants which probably may have had something to do with its scalariform nature; the pond, however, in which Mr. Gude found what I have called var. *elegans* is personally known by me as containing but scant vegetation. As both these varieties are subscalarid and since one of them was found in a pond clear of vegetation, it seems to me that subscalarid specimens are not always explicable by the theory of Van den Broeck, who considers them as adaptive modifications. It seems but right, in conclusion, to say that Cockerell has described two varieties of *Limnæa stagnalis* as m. *scalariforme* and v. *elegantula* (the types of which I have examined), but these are quite distinct in general form from the varieties here named and described. Cockerell's two varieties will be found figured and described on pp. 78 and 79 of my "Shell-collector's Handbook for the Field." The description of m. *scalariforme* is "whorls disunited;" that of v. *elegantula* is "shell dark in colour, nearly scalariform; suture deep." The type of the former is in the National Collection in Cromwell Road, South Kensington; the type of the latter is to be found in the Museum of the Middlesex Hospital Medical School, London.

Reviews.

A Flora of Herefordshire. Edited by William Henry Purchas, Vicar of Alstonfield, Staffordshire, and Augustin Ley, Vicar of Sellack and King's Capel, Herefordshire. 8vo, 21s. Hereford: Jakeman and Carver.

FEW works are more interesting to the botanist than a reliable and well-compiled Flora of a district. To possess these characteristics it should proceed from those having a practical knowledge of our native plants, judgment to discriminate species from sub-species, and native plants from aliens, casuals, and the like. If, in addition to this, special features in the habit and distribution of the plants are given, it will add to our knowledge and materially increase the interest of the

work. It should also be a faithful record of all plants observed, whether native, alien, or casual, care, however, being taken to convey to the reader the true status of each plant recorded. Such a flora is a real gain to Science, and such a flora is the one now under review; in all the points mentioned it is all that can be desired.

But beside this there should be not only a general account of the district, but also of its area, extent of cultivation, with some account of its meadows, woods, rivers, marshes, heath lands, and the like, with comparative lists of the plants of near or contiguous districts; in this respect the Flora of Herefordshire is scarcely level with the times. Still its excellencies are great, and quite condone for its short-comings.

The work opens with a preface in which the authors acknowledge their indebtedness to some of the higher lights of botanical science, and give a short history of the progress of Botany in Herefordshire, together with the names of many of the past and present botanical investigators of that county; and from this we learn that so far back as 1845 Mr. Purchas, the elder of the editors, had made an almost complete list of the plants of Herefordshire, so that the work of which this volume is the record was commenced nearly half a century ago. A summary of the Flora of Herefordshire was published in the Woolhope Club Transactions of 1867, and in this 863 species were recorded. In the present work, which is the first separate Flora of that county, we have 903 species recorded.

A few of the greater elevations and characteristics of the Black Mountain and Malvern Hill ranges are also given. From these we learn that the highest point of the county is attained on the Ffwddog ridge of the Black Mountain at Cwarel-y-Fan (about 2,300 feet); the extreme northern point of the Hatterill ridge, where it overlooks the town of Hay, coming next with an altitude of about 2,200 feet. Of the Malvern Range the highest point in Herefordshire is the Herefordshire Beacon, with an altitude of 1,390 feet. The undulating plain of the county has a mean altitude of about 200 to 290 feet. A description of the various grades of species is quoted from Watson's Compendium, but no general summary is given; this would have given additional value to the work. The types of distribution are described, but these types are not given in the text but are relegated to the "Index to the Phanerogamic Plants"; and here the authors have gone beyond Mr. Watson, and included under their various types many plants not so recognised by Watson. The preface concludes with an account of the rainfall, climate, temperature, &c., of Herefordshire, by Mr. Henry Southall, F. R. Met. Soc., which is both interesting and valuable. This is followed by a definition of the botanical districts of Herefordshire, by the Rev. W. H. Purchas; with notes on their geology by the Rev. W. S. Symonds, F.G.S., Rector of Pendock. This occupies twenty-eight pages, and is a very full account.

The county is divided into fourteen districts, the division being a purely artificial one; but, as this is accompanied by an excellent map, little is left to be desired. No plan of the Flora is given, but the reader learns incidentally on page 3, in a note on the White-flowered Aquatic Ranunculi: "The division and names here adopted are, as elsewhere in this Flora, those of the London Catalogue of British Plants, Ed. VII., 1874. Although in the case of the plants now under consideration, its classification cannot be considered very fortunate or instructive."

Following the account of the districts is the Flora, which includes the Flowering Plants, Ferns, Mosses, and Fungi, and occupies, with the

Appendix, 529 pages of really small print. In this Mr. Purchas is responsible for the notes and determination of the Brambles and Willows, Mr. Ley for those on the Roses and Mosses, and various distinguished members of the Woolhope Club for the Fungi. This portion of the work reflects the highest credit on both authors; is brimming with information gleaned by extensive reading, made charmingly interesting by the copious notes on many of the critical genera and species; and all the way through the reader feels he has before him the results of the experience and close observation of capable workers in Botany. The weak part of the Flora is the Batrachian Ranunculi, which the authors have evidently shunted; but the Brambles are very ably treated, so also are the Roses and the Willows. The account of the distribution of the Mistletoe is very full, Herefordshire being evidently its headquarters. This record is mainly copied from a valuable paper by Dr. Bull in the Transactions of the Woolhope Club, 1864, and gives in every case the host-tree upon which the plant has been observed, and the list is quite an instructive one. Long notes are also given on the Oak, the Beech, the Helleborines, and *Juncus tenuis*, which is an interesting addition to the English Flora.

The account of the Mosses of Herefordshire, by Mr. Ley, reflects the highest credit on his industry and close observation. The list is a very full one, and many of the species recorded are among the rarest of our British species, one of these, *Bryum versicolor*, being new to the British Flora.

The lists of the Fungi of Herefordshire, "which were originally compiled by Dr. Bull, and after his death were elaborated by Dr. Cooke and Mr. Phillips," are the result of the keen search of the ablest and best of our British fungologists for a long series of years, and testify not only to the industry of the members of the Woolhope Club, but also to the peculiar fungus wealth of Herefordshire. This account occupies seventy-one pages, and comprehends the whole of the great groups from Agaricus to Myrothecium.

The list of Fungi is followed by an Appendix, in which we have an account of the plants added to the Flora during the time which has elapsed since the earlier pages were printed; a Corrigenda in which the comparatively few mistakes to be found in the text are corrected, and three Indices.

The following summary will show the richness of the record in this volume :—

Phanerogams	865
Filices	26
Lycopodium	2
Equisetum	6
Characeæ	4
Casuals	63
Varieties	96
Musci	288
Varieties	20
Fungi	1,097
	2,467

The work is illustrated by a large and well-printed map showing the botanical districts, and three plates on which are delineated *Epipactis ovalis*, *Epipogum aphyllum*, and *Juncus tenuis*. It is well printed, the type being clear though small, and in every way reflects credit on the authors and their publishers. J. E. BAGNALL.

A Handbook of Cryptogamic Botany. By A. W. BENNETT and GEO. MURRAY, with 378 Illustrations. 473 pp. Price 16s. Longmans, Green, and Co., 1889.

THE foundations of this handbook—the first published in the English language since 1857—are the works of Goebel and De Bary, whose methods are followed, and from whom and similar sources many of the illustrations are, by permission, borrowed. It is, therefore, a presentation of the biology and classification of cryptogams according to modern German methods, and every attempt has been made to include all recent discoveries up to the time of publication. The figures, as will be seen, are very numerous and seem to be all carefully chosen, so as to help the understanding of the text. It is natural to judge of the value of a book which traverses so wide a field by examining that portion of which one has the most intimate knowledge; and, estimating this by its treatment of the Fungi, it is not too much to say that it stands alone among English works in giving a comprehensive view of the subject in its modern aspect. To one who has been confined to the old-fashioned treatment in vogue in English treatises on systematic mycology, it will be a revelation of a new world. A praiseworthy attempt is made to simplify the nomenclature of the parts described by anglicising the terminations; thus *antherid*, *mycele*, *apothece*, *archegone* are formed by dropping the usual ending, although *prothallium*, *indusium*, and others remain untouched; and, as far as possible, the same term is used throughout for homologous bodies. One of the most enjoyable proofs of the independence of the authors in this respect is that they have refused to follow the debasing German practice of using the word *gonidium* instead of *spore*. It certainly requires a German mind to appreciate the charms of such a word as "macrozoogonidium;" *megazoospore* is sufficiently long. The reasoning, moreover, by which the change was attempted to be enforced by German despots, was characteristically weak and pointless; if it is right to mark the distinction between sexually and asexually produced means of multiplication by a difference of term (as, no doubt, it is), a comparison of previous nomenclature shows that the word "spore" has been used twenty times in the latter signification for once when it has been used in the former; and, therefore, convenience, which overrides all other considerations, requires us to invent a new term for the sexual product rather than for the asexual. Thus the authors of this work are no mere slavish copyists of German magnates, and even those who are acquainted with the original authorities will find much that is new and much that is interesting in their treatment of the subject. An especially well-written part is that which treats of the fossil vascular cryptogams. W. B. G.

Young Collector Series. Land and Fresh-water Shells. By J. W. WILLIAMS, M.A., D.Sc. London: Swan Sonnenschein & Co.

THIS little manual is undoubtedly one of the best of the series. It begins with a chapter on collecting land and fresh-water shells and their inhabitants; then follows a capital description of the anatomy and physiology of the snail and fresh-water mussel. These latter chapters are admirable, and form a very important and valuable feature of the book; they certainly ought to inspire the reader to investigate the differences in the soft parts of the various species in addition to collecting their shells. Then comes a classification of the group, with a minute description of the various British species and varieties; a chapter on the geographical distribution of these, by Messrs. J. W.

Taylor and W. Denison Roebuck, closes the book, which is very good in all respects. We can only suggest that in a future edition a few references should be given to the great standard works on the subject, where the "Young Collector" would find accurate pictures of the different shells to aid him in their identification; such works are usually to be found in most large public libraries. A. B. B.

Wayside Notes.

MANCHESTER MICROSCOPICAL SOCIETY.—From the annual report for 1888 we learn that the Society consists of 222 members, and is in a flourishing condition. The transactions for the year include some interesting and valuable papers. One of the best is the Presidential Address on "Inheritance," by Professor A. Milnes Marshall, F.R.S. Some suggestive details are supplied of a course of systematic histological instruction given by members of the Society; and other societies of the same kind might, we think, follow their example with advantage. The work done was the demonstration of the Structure, Chemistry and Physics of the Vegetable and Animal Cell. The course lasted about six months, and at the closing meeting of the session the chairman gave a *resumé* of the work done, and there was an exhibition of nearly 100 slides under the microscope illustrative of the subjects of the demonstrations made during the course.

UNIVERSITY INTELLIGENCE.—Mr. G. C. Druce, of Oxford, a frequent contributor to these pages, and author of "The Flora of Oxfordshire," has had his merits as a scientific botanist honourably recognised by the University of Oxford, which has conferred upon him the distinction of Honorary M.A. Another of our contributors, Mr. A. Bernard Badger, B.A., of New College, Oxford, has added to the previous honours won by him at the same University. Last year he was placed in the First Class of the Final School of Natural Science after an examination in Morphology (Comparative Anatomy). This year he has again been placed in the First Class of the same Final School after an examination in Geology, thus achieving the distinction of a Double First Class. He has also during the present year been elected to a Burdett-Coutts (University) Scholarship, which is given "for the promotion of the study of Geology and of Natural Science as bearing on Geology." The following are some of the eminent men who have been Burdett-Coutts Scholars: Professor W. Boyd Dawkins, F.R.S. (1861), Professor E. Ray Lankester, F.R.S. (1869), and Mr. E. B. Poulton, F.R.S. (1878).

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION.—Thursday, May 23rd. Mr. W. R. Hughes, F.L.S., in the chair. Miss Byett gave her exposition of the XVII. chap. of Herbert Spencer's "First Principles," entitled "Equilibration."—Tuesday, May 28th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Bagnall exhibited, for Miss J. R. Gingell, *Polygonatum officinale*, *Convallaria majalis*, *Neottia Nidus avis*, *Habenaria bifolia*, *Cardamine pratensis* with double flowers, and *Paris quadrifolia*, showing variations in the number of floral leaves. Mr. W. B. Grove exhibited, for Mr. Wilkinson, *Trichobasis scillarum*, from the Lickey Hills. Mr. Hughes read his paper on "A Trip to Dickens's Land," which gave

an account of the home of Chas. Dickens, Gadshill Place, Higham, by Rochester, Kent, describing its geological, historical, and picturesque aspects, and especially its present condition, which is practically unchanged since the death of the great novelist, owing to the admirable manner in which it has been kept up by its present owner, Major Austin F. Budden.—MICROSCOPICAL SECTION, June 4th. The President in the chair. Mr. W. B. Grove, M.A., exhibited *Ustilago hypodytes*, on culms of *Elymus arenarius*, from the shore at St. Andrews, N.B.; Mr. T. E. Bolton, living specimens, under the microscope, of *Trichophrya epistylidis* and *Leptodora hyalina*; Mr. W. H. Wilkinson exhibited some rare lichens from Dr. Stirton, of Glasgow: *Usnea longissima*, *Roccella fuciformis* var. *Montagnei*, in fruit; *Parmelia hottentotta*, *Parmelia Kamtschadalis*, and *Endocarpon Moulinsii*, from India; *Parmelia Millaniana*, from Scotland; and *Lecanora homologa*, from New Zealand; also a section of the latter under the microscope, showing the peculiar three or five locular spores. A paper by Mr. E. W. Burgess on "The Pocket Dredge for Microscopic Objects, &c.," was then read by Mr. W. P. Marshall, M.I.C.E., which will appear in the "Midland Naturalist." Mr. Marshall stated that the proposed dredge was similar to one in use by the society, except in being open at the bottom, and in the first four feet of rope being of wire, in front of the dredge, to prevent abrasion by dragging on the ground. A discussion upon its merits took place in which the President, Messrs. Goode, Reading and others took part. A vote of thanks to Mr. Burgess was passed, a copy of which was to be forwarded to him.—SOCIOLOGICAL SECTION.—Thursday, June 6th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Browett gave his exposition of the XXIII. chap. of Herbert Spencer's "First Principles," entitled "Dissolution."—GEOLOGICAL SECTION, June 18th. Mr. T. H. Waller in the chair. Exhibits:—Mr. W. B. Grove, 1, *Polyporus elegans*, from the slopes of Scaw Fell, near Wastwater; 2, *Puccinia Betonicæ*, from Rosthwaite, Borrowdale. Mr. A. Browett, 1, *Polygala vulgaris*, common milkwort, from Buxton; 2, *Sanguisorba officinalis* (Great Burnet), from Harborne Fields. Mr. W. H. Wilkinson, *Clianthus pulchellus*, sometimes called the crab's claw, and at other times the parrot's beak, from the shape and colour of the rich red blossoms. These blossoms were gathered from a climbing plant growing out of doors in North Devon. Mr. Herbert Stone, Nidus of a spider, *Epëira fusca*, from Sherwood Forest. Mr. Jno. Udall, various hand specimens of rocks from Colwyn Bay. Mr. Waller read a paper on "Picrites," and illustrated it by some very choice hand specimens and micro-sections. A hearty vote of thanks was accorded.—SOCIOLOGICAL SECTION.—Supplementary Meeting, June 20th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Hughes announced that he had received a number of communications from the Brooklyn Ethical Association, including copies of the following documents:—A resolution passed by them thanking Mr. Herbert Spencer for his assistance and advice to them when forming the association, and congratulating him on his improvement in health. A letter to M. Grosclande, of Paris, on the progress of philosophy in America, and the address of their President at the conclusion of their first session. Also a letter of thanks to the members of the Sociological Section for their congratulatory resolution recently sent them. Mr. Hughes proposed, and Mr. Grove seconded, "that the letter be entered upon the minutes." It was also resolved "that the whole of the correspondence be left in the hands of the President, Mr. Kineton Parkes, and Mr. Herbert Stone for the purpose of giving it publicity." Mr. W. B. Grove, M.A., gave his address on the "First Principles" of

Herbert Spencer, being a summary and conclusion of the same. He said that this work, the study of the second part of which the Section had just concluded, was a superstructure erected upon the one datum, the "Persistence of Force," which he understood to mean that no effect was conceivable without a cause, and conversely that no cause was conceivable without its effect. He then proceeded to trace the development of the various phases of Evolution as set forth in "First Principles," and showed how they followed from the primary assumption. The lecturer laid particular stress on the fact that people in general overlooked the process of Dissolution, which rhythmically alternates with the upward movement of Evolution, and that, when Being arrives at a state of complete equilibrium, owing to the continued redistribution of motion, Dissolution will then commence, and continue until it reaches perfection, when Evolution once more will take place.

OXFORDSHIRE NATURAL HISTORY SOCIETY.—Tuesday, May 28th. The President in the chair. Mr. F. Gotch, M.A., gave a lecture on the "Electric Organ in Fishes." It was profusely illustrated with specimens, both dried and in spirits and also microscopical, by diagrams, and by lantern slides on the screen. The lecturer said that, like first-class and second-class men-of-war, there were first-class and second-class electric fishes. The three "first rates" known were the torpedo, a native of the Mediterranean, Bay of Biscay, Red Sea, and elsewhere; and two fresh water fishes, the electric eel of the Amazons and the electric barbel of the Nile. The common skate of our own shores was a "second rate" electric fish. He first gave a history of the torpedo and Nile electric barbel as known to the ancients. They were of opinion that the shock given by these creatures was a sudden frost or intense cold, sent forth at will. The electric barbel appeared in Egyptian hieroglyphics—unmistakeable from its very long barbels and antennæ. The *electric* power of these fishes was first discovered by a French physician who lived in the Isle of Rhé. That the shock was indeed due to electricity was scouted as "impossible" by the English savants of the time, but the fact was soon conclusively proved by ingenious experiments. In the torpedo the electric battery consisted of four masses of short hexagonal columns, two at the head and two at the tail, the pair at the head being much the larger. In the eel about seven-eighths of the entire length of the fish were taken up by the battery, which lay on each side of the spine, only about one-eighth at the head being occupied by the digestive organs. These eels sometimes attained a length of seven feet or more. The barbel was quite a small fish, six to nine inches long, but very powerful, and a great deal of its body was taken up by its batteries. After briefly explaining the action of the electric current in the voltaic "pile," Mr. Gotch described the minute structure of the batteries of these fishes. They were made up of what were in fact "voltaic piles," each column being one pile, consisting, as in the piles which we make, of plates with differing surfaces laid one on another. In the skate there were only sixty or seventy plates to the inch; in the Nile barbel some 500. The electric power of the fish partly depended on the number of its plates to the inch, and partly on the number of successive shocks which it could give in a second; the more plates and the more impulses, the greater the power. The plates were excited by the brain power of the fish; it only gave a shock "when it was minded" to do so. The shock given by the skate was very feeble—hardly perceptible to our senses—but a powerful torpedo, which would transmit from 105 to 130 impulses *per second*, would give a man such a shock as to disable his arm or leg for the rest of the

day. And even a baby torpedo, no bigger than half-a-crown, gave him (Mr. Gotch) such a shock on the hand that he was obliged to drop it. Speaking of the uses of this electric power, he believed that in all three fishes it was used for defence, and in at least the two fresh-water kinds for offence also. Salt water was a hundred times a better conductor of electricity than fresh water. Consequently a shock was sooner dissipated in it, and so would be felt less by an animal at a little distance, while in fresh water the shock would travel further, and so be felt more by surrounding fishes. The torpedo gave a very severe shock to anything in contact with it; but the electric eel could shock things at a little distance quite as severely. And so the power of the torpedo, while quite as useful for defence as that of the fresh-water eel, would not serve so well for offensive purposes. That the eel does use its power for attack, he knew, because he had seen the one at the Zoological Gardens feed in this way. By putting its nose to its tail it completed the circuit, and sent a shock through the water, temporarily paralysing all the sticklebacks in the tank. Then (it was a very sluggish fish) it eat as many as it wanted, while the others gradually recovered and were ready for its next meal. Mr. Gotch concluded by relating an amusing story of the way in which the electric barbel feeds. One of these and a fish which was non-electric were kept in the same tank. The non-electric fish had an enormous appetite for worms and other things, but the electric barbel would never touch even a wormlet, yet it seemed in good health and condition. Observation revealed the fact that the non-electric fish *ate for two.* Always after a full meal the barbel would swim gently over him, and whisk his barbels and antennæ against him, thus effecting an electric discharge. The non-electric fish straightway disgorged his worms, which the electrician immediately ate. One day, alas, he shocked his friend too much, so that he died of it, and the electric barbel, being unable or unwilling to eat fresh worms, soon pined away and died too. Mr. G. C. Druce showed fresh specimens of the bird's nest orchis and the small helleborine, both found in the neighbourhood, and Mr. M. S. Pembrey exhibited a "thrush's anvil" (*i.e.*, the stone on which the bird cracked his snails), and some of the broken snail shells.—Tuesday, June 4th. Excursion to Stanton Harcourt. Nineteen members and friends drove through Cumnor to Bablock Hythe Ferry, where a little botany and ornithology was done. At Stanton Harcourt they saw Mr. Arnatt's collection of birds, and went over the old Harcourt House, *i.e.*, the Church, Pope's Tower, and the Abbey Kitchen. On the way home some dozens of the Painted Lady butterfly were seen flying in the sunshine, just before sunset, like moths.—Tuesday, June 11th. The Rev. J. W. B. Bell, vice-president, in the chair. There were two lectures this evening—one by Professor J. Westwood, M.A., on "Stingless Bees and Irregularly-shaped Honey Pots," and the second by Mr. O. H. Latter, on the "Life History of the River Mussel." Professor Westwood described these curious little bees from Borneo, and showed the peculiarities of their honeycombs. Mr. Latter gave the results of his observations as far as he had at present worked out the life history of the mussel. Although he could not yet give the complete cycle, he related some very curious facts concerning the development of the embryos and the structure of the gill plates, which are used not for breathing only, but also in the shelter of the young. This meeting concludes the series of indoor meetings for the season.

ERRATUM.

Page 135, line 11, "Quarterly Review" should be "British Quarterly Review."

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

We have great pleasure in publishing the following excellent programme, arranged by the Oxford Natural History Society for the forthcoming meeting of the Union. We urge all members who intend being present at the Oxford meeting to send in their names without delay to Mr. Underhill, whose address will be found in the programme.

PRELIMINARY PROGRAMME.

Meetings at Oxford, Monday and Tuesday, September 23rd and 24th, 1889.

President:—Mr. E. B. POULTON, M.A., F.R.S.

The Oxford Society cordially invites members of Natural History Societies and their friends to the meetings of the Union. The following is the preliminary programme :—

Monday, September 23rd.

1.45 p.m. Meet at the University Museum in the Parks.
2 to 3.30 p.m. Members of the Oxford Society will conduct parties of visitors over Oxford.
3.30 p.m. to 4.30 p.m. Afternoon Tea in the Museum.
4.30 to 6 p.m. Inaugural Address on "Heredity" from the President, Mr. E. B. Poulton, M.A., F.R.S., to be followed by a discussion.
8 to 11 p.m. CONVERSAZIONE IN THE MUSEUM.

Every effort will be used to make this soirée one of great interest, and a full programme will be printed on the tickets for the meetings, and also (it is hoped) in the September number of the "Midland Naturalist."

Tuesday, September 24th.

9.30 to 12.30. Drive to Shotover Hill and Lecture by the President on "The Geology of the District."
1 to 2 p.m. Lunch in Christ Church Dining Hall.
2 to 6 p.m. Special arrangements will be made both on this and on Monday afternoons for visiting the Museum, Ashmolean, Radcliffe Observatory, Botanic Gardens, Bodleian Library, and Clarendon Printing Press.

The tickets for the meetings will be 10/6 each. There will be no extras. Those who intend to visit Oxford are requested to write to the Secretary, Mr. H. M. J. Underhill, 7, High Street, Oxford, as soon as possible.

The Oxford Society will provide entertainment for as many visitors as they can, and this hospitality will be allotted

to visitors according to the order in which their application for tickets is received.

For those who prefer it, or who cannot be entertained, information concerning lodgings and hotels may be had on application to the Secretary.

The Secretary will be glad to receive communications from any members who have interesting exhibits to show at the conversazione.

H. M. J. Underhill,
Secretary of Oxford Natural History Society.
7, High Street, Oxford.

THE PETROLOGY OF OUR LOCAL PEBBLES.*

BY T. H. WALLER, B.A., B.SC.

The great pebble beds of the district round Birmingham are probably familiar to all the members of this Society, to many of them far more so than they are to myself. My opportunities for collecting specimens from them have been very few and far between, and as I am not likely to be able to give much more time and attention to the subject in the future than in the past, it seemed as if a sort of interim report on the petrology of the pebbles might be of service in stimulating to a closer study of the deposits some who can give more time to the matter than is possible for myself.

At any rate, whatever we know of the gravel and pebble pits, and the occurrence of the pebbles *in situ*, we all know the general appearance of the component pebbles. Many of us no doubt have examined them a little more closely, and have observed that by far the larger number are composed of some form of quartzite, and it is some of these quartzite pebbles that have furnished to the minute search of several indefatigable workers amongst us (Messrs. Harrison, Evans, and others) those rare and proportionably valuable fossils to which we must look to indicate the geological horizon of the rock masses from which the fragments were torn, which, after the rough knocking about which has rounded them, and smoothed—indeed, in many cases almost polished—them, went to make up the great formation of the Bunter pebble beds.

Professor Lapworth has indicated, in the lecture to which we listened with such pleasure and profit some six months

* Read before the Birmingham Natural History and Microscopical Society, 19th March, 1889.

ago, the physical conditions in which, judging by the analogy of what is going on at the present time, these beds accumulated: he has pictured to us the mountain torrents bringing down their loads of stones from the interior of the great mountain ranges, and depositing them where they emerge from the mountains on to plains, where the fall of the ground was insufficient to produce the current necessary to carry the burden further. In this transportation it is plain that a very powerful process of selection would go on. The harder rocks would evidently be those which would be the fittest to survive, and we all know that these pebbles are about as tough and intractable as any stones we have to do with.

Now the quartzite composing the pebbles is certainly in great part very different from any rock which at present appears at the surface in the Midlands, or indeed for very long distances from us. We have quartzite formations at the Lickey, Nuneaton, the Wrekin, and further off in the borderland of Shropshire and Wales; but, so far as I know, these would only furnish *one* of the types of rock which we find in the pebble beds. Of the other types which, from their structure, cannot, I think, have been mere local variations in a quartzite mass, the present exposures afford no examples.

The origin of the pebbles—the direction in which they have been brought into the district—has been vigorously discussed, and is at the present time quite unsettled.

Professor Bonney has minutely examined the formation principally in the area of Cannock Chase, and believes that great rivers or shore currents brought the stones from the North, even finding parallels for some of the rocks in the Torridon sandstone of the far Northern Highlands. It has been objected to this view that the pebble beds attain their maximum of thickness and of richness in pebbles about the district of Cannock Chase, where they reach a thickness of 800 feet; while, as they are traced further north towards Nottinghamshire on the one hand, or Liverpool on the other, the pebbles become fewer and ultimately disappear, the rock becoming first a pebbly sandstone, then a sandstone with occasional pebbles. Further north still, in Yorkshire, they are altogether wanting, the lower mottled sandstone being the only representative of the Bunter, while at Carlisle the Keuper beds are the only representatives of the Triassic strata.

I have taken the above summary from the important paper read by Mr. W. J. Harrison to the Philosophical Society in this city in 1882, on the derivation of the quartzite pebbles of the Drift and the Triassic strata. In this paper he shows reasons for believing that the pebbles came from the west.

He points out that the lines of false bedding of the Bunter beds indicate almost invariably currents sweeping from the west or north-west, and quotes Mr. Sorby's observation that, in examining a large number of specimens of New Red Sandstone from various localities lying in a north and south line from Scotland to Devonshire, "what struck me most was the comparatively uniform extent of the wearing," inferring that "we cross the line of drifting transversely from north to south." The fossiliferous pebbles do not seem at present to throw much light on the situation of the parent rock.

The celebrated pebble bed of Budleigh Salterton, of Lower Keuper age, has been very carefully examined for some years, and the fossils found in the quartzites there are such as are contained in no British rock; while across the Channel, in Normandy and Brittany, Silurian and Devonian quartzites with similar fossils do occur. The Devonshire geologists have, says Mr. Harrison, located the home of their travelled quartzites under the water of the English Channel, and it is probable that most of the rocks which furnished the Midland pebbles now lie beneath a mass of newer strata by which they are covered over and concealed.

Into the question of the fossil contents of the stones I am quite unable to enter; but I owe many specimens to the kindness of Mr. A. T. Evans, who, while engaged in what must be the wearying search for organic remains, has collected examples of other rocks, which I have thus been able to examine. These are mostly from the King's Heath pit and from Sutton Coldfield. I have collected a considerable number of specimens from Sutton and from the Alvechurch district, although I should be inclined, for reasons to be stated later, to consider most of these as forming the glacial rewash of the Bunter beds with some admixture of rocks of which the place of origin is much less obscure.

As such a large majority of the pebbles are quartzite, it will, perhaps, be best to consider these first in somewhat of detail. These I have studied principally from Sutton specimens, particularly from the pit by Blackroot Pool. At this pit the pebbles are often cracked in a very peculiar manner; all the planes of fracture lie vertically, or nearly so, in the natural face of the digging, and occasionally they are seen to originate in two pebbles at the points at which the two are in contact. When this is the case, it is not the side contacts, but the vertical ones, from which the cracks start. I hence conclude that the pressure which has cracked the pebbles was exerted in a vertical direction, driving them against each other.

Another curious thing may also be observed in the same pit, namely, hollows in the sand, which, on careful examination, are found to have the usual ovoid shape of the pebbles of the bed, but to contain only a few internal casts of shells or encrinite stalks lying loose in the hollow, showing that the cavity was originally occupied by a pebble of limestone, which has been dissolved out by the carbonic acid contained in the water which has percolated through the mass since its deposition. I should think also that it is evidence that the crush which has cracked the pebbles took place at a comparatively early epoch of their existence, as we might expect an empty space to be disturbed by such a pressure. In a cutting on the Midland Railway to Walsall, a short distance to the west of this place, I observed, during the construction of the line, a multitude of small faults (with throws of from an inch or so to a foot) extending over about half a mile. Every now and then one could be met with of more considerable throw, say two or three feet, and the pebbles were all perfectly crumbly under the hammer, seeming perfect outwardly, but simply falling to pieces at the slightest tap; a circumstance which had been of great annoyance to the contractors for the line, as they had looked to this stretch of gravel for ballasting purposes.

Of the quartzites we recognise several varieties. One is pure, dense, white, with a fracture crystalline and glistening almost like loaf-sugar; another is almost black, another honey-yellow, another banded. We find occasional examples also of a less solid-looking rock, more like that of the Lickey and Hartshill, and, among the quartz grains of this, bright pale green grains are observable. They are of a soft, earthy consistence, and of course totally disappear during the preparation of thin sections.

A somewhat closer observation of the principal varieties of quartzite, as they show themselves under the microscope, opens up several points of interest, and I will describe the main peculiarities of eight sections which I have made.

(1) A dark quartzite (1) from Sutton.

The component quartz grains are mostly angular and of moderate size, averaging ·005 to ·008 of an inch in diameter. They are cemented by a quartz which is in most parts cloudy and apparently dirty. Some of the original grains are also cloudy, with minute inclusions, while others are very pure and clear. The irregular clouding between crossed nicols due to strain by pressure is very common. In the quartz grains are contained many minute rounded granules with high double refraction, showing therefore in brilliant colours between

crossed nicols when the quartz grain in which they are contained is in the position for extinction. A considerable number of flakes of a white mica lie among the quartz grains, but do not appear to belong to the original quartz, as they do not traverse the grains. Rounded grains of zircon, or at any rate of a mineral of very high refractive index, and of a white or pink, some even of darkish pink colour, occur pretty frequently in the quartz; and a few fragments of tourmaline, showing the characteristic dichroism, are scattered throughout the section. Only very few grains of felspar are recognisable; one shows multiple twinning.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

BY W. B. GROVE, M.A.

(Concluded from page 141.)

The surfaces of all plants, the feathers of birds, the skins of animals, the human face, hair, hands, and garments, are all covered with Bacteria, or their spores, that have fallen upon them from the air. The ground itself receives, of course, the greatest number, and yet it is found by actual cultivation that the Bacteria of the soil are not entirely identical with those of the atmosphere. In the air, Miquel found by experiment that five kinds are always present, although he appeared to be incapable of deciding what those kinds are, with the exception of *Cladothrix dichotoma.*

In the soil the Bacteria are confined to the superficial layers; at a depth of 2ft. hardly any are found, and at a depth of 8ft. none. If particles of soil are crushed fine, and then sown on the surface of solid nutrient gelatine, as was done by Koch, we see the Bacteria which were in the soil develop in a number of little colonies. By this means Miquel has calculated that there exist in a grain of soil of the Park of Montsouris, on the average, 50,000 bacterial germs, and in the streets of Paris between 100,000 and 150,000. Adametz found in a grain of ordinary garden soil about 30,000. These are chiefly the putrefactive and fermentative Bacteria, but the pathogenic (disease-producing) species can also occur in the earth; when sheep that have died of anthrax are buried, the soil is permeated with the spores, which are conveyed to the surface by earthworms,

and thus infect with the disease the flocks which may be feeding on that spot.

Certain kinds of Bacteria that are found in soil are believed by many observers to have a very important effect upon it from an agricultural point of view. This is especially true of some species of Micrococci ; one, *Micrococcus nitrificans*, was so named because it was supposed to be the especial seat of this power, by which the ammonia, or even the free nitrogen, in the interstices of the soil was oxidised with the formation of useful nitrates. Another species, *M. cereus*, has also been described as a " very efficacious nitrifying agent." But considerable doubt has been thrown upon this belief by two other alleged facts : (1) That the nitrifying action goes on in soil in which no Bacteria can be detected, and (2) that "pure" cultures of some of the species said to produce this effect exhibit no trace of the power. Others have attributed the chemical action to the soil itself, which is supposed to act like spongy platinum, and condense the gases in its interstices. Moreover, there seems to be equal proof that some microbes can denitrify, decomposing nitrates and evolving ammonia or free nitrogen. It may be that in both cases the action is merely an inorganic one, and that the Micrococci are only accidental accompaniments of the process ; or it may be that the very same organisms can nitrify or denitrify, according to circumstances.

Since the lower strata of the soil contain no Bacteria we should expect that pure uncontaminated cold spring water, coming from a sufficient depth, would also contain few or none. This may be proved by spreading a minute drop, taken directly from the source, on the surface of sterilised gelatine. In most cases no colonies will be developed. Deep well-water contains very few ; ten have been found in a cubic centimetre. Tap water shows from 57 to 1,950 per cubic centimetre ; but after rain the number increases. But the slightest exposure alters the condition of the water at once. From 50,000 to 100,000 have been found in a litre of water from a brook, and as the brook descends to the sea it rapidly becomes more contaminated.

Ordinary drinking water contains *Micrococcus aquatilis* and *Bacillus erythrosporus* in small numbers ; but if it remains standing, at ordinary temperatures (say 20° C.), rapid multiplication takes place. But there is a consolation in the following well-proved fact, that those species which propagate under such circumstances belong to the harmless kinds. Pathogenic Bacteria cannot live in ordinary spring water, but only if it contains decomposing organic matter. When introduced they never multiply, and after a time totally

disappear. A litre of rain water may contain 248,000 microbes; a litre of water from the Seine, at Bercy, has been shown to contain 4,800,000, and at Asnières 12,800,000; while water of impurer character showed the enormous total of 80,000,000 per litre. These numbers may, perhaps, be better comprehended if I say that they vary from 80,000 in a pint of brook water to 50,000,000 in a pint of the liquid which is called the Thames at London. Even ice contains many, especially if "bubbly"; the water derived from melted hailstones is often thronged. Prolonged freezing is no doubt fatal to the majority, but a temperature many degrees below freezing point is required to kill them all.

Of course, if the earth on which we grow our food, the air we breathe, and the water we drink are thus permeated by these countless numbers of microbes, it must needs follow that the human alimentary canal is full of them. They abound in the mouth, especially clustering round the teeth, and it is a remarkable fact that we can assert without a doubt that the species of Leptothrix, which is peculiar to this latter habitat, has always existed there; for Zopf and Miller discovered, isolated, mounted, and even stained, the Leptothrix from the teeth of Egyptian mummies. Nor is this antiquity all that can be proved of Bacteria. Far, far before this, in the dim light of carboniferous forests, *Bacillus Amylobacter* rioted in the decaying cells of plants as it does at the present day, and has left its traces behind in fossil leaves and stems, recognisable even after the lapse of so many ages by the exact similarity of its action to that which we now observe.

In the stomach, and especially in the intestines, the number of Bacteria enormously increases, and is greatest in the large intestine. It is not improbable that they play an important part in the digestion and assimilation of our food; this is certainly their function in the stomachs of herbivorous animals. But in the blood and in the healthy tissues of the body it is probable (according to the evidence of the best experimenters) that they are entirely absent. Those observers who think they have discovered signs of their presence there may have been misled by faulty methods of experiment, although it must not be forgotten that the presence of micro-parasites (not belonging, however, to the Bacteria) in the blood of healthy rats is an admitted fact. In any case, if any microbes are present in such places, they are only occasional intruders.

But this suggests the question—how are they kept out? The particles of chyle which are absorbed by the walls of the intestine are much larger than the Bacteria, and there is, therefore, so far, no reason why they should not be absorbed,

equally with the chyle, by the lacteal vessels, and thus carried into the general circulation. On the contrary, there is distinct evidence that they are so carried. The lymphatic tissue of the Peyer's glands of the intestine of perfectly healthy rabbits has been shown to contain numbers of Bacilli, and they are sometimes found in the amœboid cells of the blood. But there they are already dead; the putrefactive Bacteria of the intestine must be killed, nearly immediately, by contact with living cells.

This question of the fate of microbes in the blood of warm-blooded animals has been carefully investigated. Living saprophytic Bacteria of the following species:—*Bacillus subtilis*, *B. acidi-lactici*, *Micrococcus aquatilis*, *Spirillum tyrogenum*, were injected into the blood, and not a trace was visible after three hours. Even those which are pathogenic to man (but not to the animal experimented upon) disappeared in from three to four and a half hours, as *e.g.*, *Micrococcus tetragonus*, *Bacillus typhi-abdominalis*, *Spirillum choleræ-asiaticæ*, and *Streptococcus pyogenes*. It was proved also that their disappearance was not effected by excretion, either through the kidneys or the intestine, and the conclusion arrived at was that they were destroyed by contact with the *endothelial* cells.

We may compare the horde of microbes to an invading army of Goths or Vandals. The cells of the living tissue wage war against the intruders to defend their homes, and, if healthy, are always victorious. But if weakened from any cause they may succumb, and then the invading regiments seize upon the dead cell, multiply, and devour it ,and make of it a vantage ground for attacking the neighbouring cells. These dead cells may be absorbed into the circulation, and the Bacteria enclosed within them may be sufficiently protected from the hostile action of the blood to remain alive for some time; and if, during this time, they are carried to any part where disintegration or inflammation has set in, they may settle there, and find an appropriate nidus for their growth. We can thus account for the presence of certain kinds of microbes in diseased tissues within the body to which they could not have had, directly, any means of access.

But if the microbe which gains entrance to the body is a pathogenic organism to the animal in question, of course, the changes which take place are of a different character. Various kinds of bacterian diseases are produced, but into this topic, though it is of unsurpassable interest, I do not intend to enter, having considered the subject from the point of view, not of a physician, but of a cryptogamic botanist.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 163.)

LEES, IN "BOTANY OF THE MALVERN HILLS."

* **Hypochœris glabra**, 38. In damp boggy spots about the base of the hills. *S.E. base of the North Hill, 1888, R. F. Towndrow. Sp.!*

H. radicata, 38.

Apargia hispida, 37.

A. autumnalis, 37.

Thrincia hirta, 37.

Picris hieracioides, 37.

Helminthia echioides, 37.

* **Tragopogon pratensis**, 37. Both forms.

Leontodon Taraxacum, 37. (*Taraxacum officinale and var. palustre.*)

* **Prenanthes** (*Lactuca*) **muralis**, 37.

Sonchus oleraceus, 37.

S. arvensis, 37.

Crepis tectorum, 37. *The plant intended is C. virens, L.*

Hieracium Pilosella, 37.

†* **H. murorum**. 37. Rocks near the Wych, 37. More luxuriant on Little Malvern Church. *I have previously expressed a doubt as to this being the true plant. It does not now grow at the Wych.*

* **H. vulgatum**, 37.

* **H. boreale**, 37.

* **Campanula rotundifolia**, 17.

* **C. patula**, 17. Ill.

* **C. Rapunculus**, 17. Near Bromsberrow.

* **C. latifolia**, 17.

* **C. Trachelium**, 17.

* **Vaccinium Myrtillus**, 21. On some eastern rocks of the Worcestershire Beacon, and in woods north of the End Hill. Ill.

* **Calluna vulgaris**, 21.

"N.B.—No species of Erica occurs throughout the chain."

* **Ligustrum vulgare**, 13. Mostly on the limestone strata. Ill.

* **Vinca minor**, 17. In a wood at the western base of the Keysend Hill; among underwood in the copse above the Lime Kilns at Leigh Sinton; also in a lane between Powick and Bransford. Ill.

* **Chlora perfoliata**, 21. W. Mostly on lime. Ill.

* **Gentiana Amarella**, 18. Abundant on calcareous soil on the western side of the hills, as near Purlieu Lane, below the Wych. Ill.

* **Cuscuta europæa**, 18. Among vetches at the Berrow, and at Cotheridge. Ill.

* **Solanum nigrum**, 18. Hanley.

* **Hyoscyamus niger**, 17. On waste ground at the Wells. Ill.

* **Verbascum Thapsus**, 17. A very conspicuous object in the Malvern Flora.

* **V. Blattaria**, 17. Occasionally by roadsides. Ill.

* **Antirrhinum majus**, 30. On old walls. Ill.

* **A. Orontium**, 30. Not very common. E. Ill.

* **Linaria Cymbalaria**, 30. Walls. Ill.

* **L. spuria**, 30. Corn fields at the Croft Farm, Mathon.

* **L. Elatine**, 31. With the last; also in fallow fields at Bushley.

* **L. vulgaris**, 31. Common.

✱**L. minor**, 31. On the borders of fields about the Croft Lime Works, Mathon.

* **Veronica hederifolia**, 14.

V. polita, 14.

V. agrestis, 14.

V. arvensis, 14.

* **V. serpyllifolia**, 14.

* **V. officinalis**, 14.

* **V. Chamædrys**, 14.

* **V. montana**, 14. Ill.

* **V. scutellata**, 14. Ill.

* **V. Anagallis**, 14. Ill.

* **V. Beccabunga**, 14.

* **Melampyrum pratense**, 30. Woods. And var. **montanum**.

* **Lathræa squamaria**, 30. Bridges Stone Mill; Purlieu Lane; Holly Lodge Grounds, Great Malvern; near White House, Berrow. Ill.

* **Orobanche major**, 31. Eastern base of Herefordshire Beacon, Hollybush Hill, and near the Wells. Ill.

† **O. elatior**, 31. From a clover field below the Abbey Church, Great Malvern. Miss Moseley's Herbarium. *This record cannot be regarded as free from doubt, as O. elatior is parasitical on Centaurea Scabiosa.*

* **Verbena officinalis**, 31. About Hanley, &c. Ill.

* **Mentha rotundifolia**, 29. Not nearer than Sapey Brook, Knightwick.

* **M. viridis**, 29. On the side of a deep ditch below the Link, some years ago.

* **M. Piperita**, 29. Plentiful on Welland Common. Ill.

M. hirsuta, 29.

* **M. gentilis**, 29. Teme side, Powick Weir.

* **M. arvensis**, 29.

* **M. Pulegium**, 29. On Barnard's Green according to W. Addison, Esq.

Thymus Serpyllum, 29. H.

Clinopodium vulgare, 30. (*Calamintha Clinopodium.*)

* **Calamintha officinalis**, 30. (*C. menthifolia.*) About the eastern base of the hills. Ill.

Melissa officinalis, 30. Hanley, near Farm Houses; naturalised.

* **Nepeta Cataria**, 29. Near the Wind's Point. Ill.

* **Salvia Verbenaca**, 14. Marl banks. E. Ill.

* **Scutellaria galericulata**, 30. By the side of Danemoor Pool, Welland Common, and by ponds on Barnard's Green. Ill.

* **Marrubium vulgare**, 30. About Welland and Castle Morton Commons. Ill.

Stachys sylvatica, 29.

S. palustris, 29.

* **S. arvensis**, 29.

Lamium amplexicaule, 29.

incisum, 29.

purpureum, 29.

album, 29.

* **Lithospermum officinale**, 16. Ill.

L. arvense, 16.

Myosotis palustris, 16.

* **sylvatica**, 16.

* **collina**, 16.

Lycopsis arvensis, 16.

* **Anchusa sempervirens**, 16. In a shrubbery near Mathon Lodge. Ill.

* **Borago officinalis**, 16. Ill.

* **Symphytum officinale**, 16. Watery meadows.

* **Cynoglossum officinale**, 16.

* **C. sylvaticum**, 16. At the eastern base of the Warren Hill, near the "Gullet." Also by the side of the road near Longdon Church.

* **Pinguicula vulgaris**, 14. Bog at the western base of the Worcestershire Beacon. Ill.

Utricularia vulgaris, 14. Pools. E. Rare. In the 3rd Edition the locality is given as near Chaceley.

* **Hottonia palustris**, 17. Only at Forthampton, south of Longdon, in a ditch near Mr. Yorke's, Forthampton Court. Forthampton is in Gloucester. Ill.

* **Lysimachia vulgaris.** 17. Longdon Marshes. Also by the weir at Powick Bridge on the Teme. Ill.

Anagallis cærulea, 16. In cornfields by the Croft Limeworks in 1841. Ill.

* **A. tenella**, 16. Abundant in the bog at western base of Worcestershire Beacon. Ill.

‡ **Centunculus minimus**, 15. Rare. H. Base of the hills near Brand Lodge. *This locality is in Herefordshire. The previous record in the "New Botanists' Guide," where no locality is given, see ante, "Midland Naturalist," Vol. XI., p. 279, probably refers to the same habitat.*

* **Samolus Valerandi**, 17. E. Ill.

* **Plantago media**, 15.

* **P. Coronopus**, 15. E. Ill.

* **Chenopodium polyspermum**, 20.

C. album, 20.

* **C. urbicum**, 20.

* **C. rubrum**, 20.

C. botryoides, 20.

* **C. B. Henricus**, 20.

Atriplex patula, 42. A synonym of the following.

* **A. angustifolia**, 42.

Rumex sanguineus, 21. *This is the form R. viridis, see Edition 2, p. 43.*

* **R. maritimus**, 21. Chalybeate Pool and Longdon Marsh.

* **R. palustris**, 21. *In the 2nd Edition the localities are stated as "Forthampton and Severn Stoke;"* in the 3rd Edition as wet spots near Forthampton. Ill.

R. acutus, 21. *A misnomer. Omitted in the 2nd and 3rd Editions.*

R. obtusifolius, 21.

R. pratensis, 21. *In the 2nd Edition the locality is given as "Longdon."*

R. crispus, 21.

* **R. Hydrolapathum**, 21. Longdon.

R. Acetosa, 21.

R. Acetosella, 21.

Polygonum Convolvulus, 21.

† **P. dumetorum**, 21. *In the 3rd Edition this name is queried.* Mr. Lees adds: "*I found either this, or a very tall variety of the preceding, in a hedge bounding Sarn Hill Wood, Bushley, some years ago, when residing at Forthampton.*" *Almost certainly P. Convolvulus var. pseudo-dumetorum. Watson. The true P. dumetorum is a plant of the south of England.*

P. aviculare, 21.

* **P. Hydropiper**, 21.

* **P. minus**, 21. In damp depressions of the wet commons, eastward.

* **P. Persicaria**, 21.

P. lapathifolium, 21.

P. amphibium, 21.

* **P. Bistorta**, 21. Ill.

* **Daphne Laureola**, 21. Woods.

Euphorbia Helioscopia, 40.

* **E. amygdaloides**, 40.

* **E. Peplus**, 40.

E. exigua, 40.

* **Ceratophyllum demersum**, 40. Longdon Marsh.

C. submersum, 40. Pools on Welland Common.

* **Parietaria officinalis**, 15. Little Malvern. Ill.

Urtica dioica, 40.

U. urens, 40.

* **Humulus Lupulus**, 42.

* **Quercus Robur**, 40, and vars. intermedia and sessiliflora. *Intermedia at Cowleigh Park in Herefordshire.*

> *"The Beech," Mr. Lees observes. "I have never observed growing wild in the district, but it is planted here and there." 3rd Edition, p. 97.*

* **Corylus Avellana**, 41.

* **Alnus glutinosa**, 40.

Salix pentandra, 41. Teme side, Powick.

S. fragilis, 41.

S. decipiens, 41. Var. of *S. fragilis.*

* **S. Russelliana**, 41. Var. of *S. fragilis.*

S. alba, 41.

* **S. vitellina**, 41. Var. of *S. alba.*

* **S. undulata**, 41.

S. triandra, 41.

* **S. amygdalina**, 41. Var. of *S. triandra.*

* **S. purpurea**, 41.

S. viminalis, 41.

S. Smithiana, 41.

* **S. cinerea**, 41, with vars. aquatica and oleifolia. *First record for var. aquatica.*

* **S. aurita**, 41.

S. caprea, 41.

* **Juniperus communis**, 42. Edges of woods near the Croft, Mathon. Ill.

* **Taxus baccata**, 42. On the Hollybush Hill, and in the woods on the calcareous soil on the western side of the hills.

(*To be continued.*) p 202

THE BATH OOLITE AND METHOD OF QUARRYING IT.*

BY ALFRED BROWETT.

At the recent meeting of the British Association at Bath, joining the excursion to Box and Corsham Down Quarries, one of the largest workings where the celebrated Bath Stone is obtained, and seeing how largely this stone enters into the building of our houses, it occurred to me that some brief account of when and how it was formed and how it is now got would not be uninteresting to the members of the Geological Section.

It is probably known to all of you that the freestone beds supplying this stone constitute the Great or Bath Oolite of the Lower Oolite Series of the Jurassic System. The rocks of the Jurassic group appear to be always of marine origin, and to have been formed at a time when sea waves rolled over the Middle and South of England. They were formed long subsequent to the coal formation, but still so long ago that not only have vast changes since taken place on our earth's surface, but the types of both plants and animals have many times changed, and not a single species then existing is now to be found.

Oolite is a granular limestone, and the grains of which it is composed are egg-shaped, and in mass resemble the eggs or roe of a fish; hence the name, from the Greek ὠὸν an egg and λίθος a stone. When these eggs or grains are very distinct, it is called Roestone, and when they are large and pea-like, it is called Pisolite or Peastone. These little grains consist of carbonate of lime arranged in successive concentric layers, like the coats of an onion, round some minute particle of foreign matter which forms a nucleus, it may be of sand or a minute fragment of coral or any such substance. Some Oolites consist only of these spheroidal grains, and are compacted by pressure; in others the interstices are filled up by fine-grained calcareous mud; others are cemented by an infiltration of crystalline calcite.

The quarries whence the stone is obtained might be more correctly termed mines, the workings being entirely underground, forming tunnels several miles in length, branching

* Read before the Geological Section of the Birmingham Natural History Society, on Tuesday, November 20th, 1888.

out in all directions. They are consequently subject to the Metalliferous Mines Regulation Act. They are cleaner than coal mines, and the ways are somewhat wider and loftier, but in other respects they are so much alike that at first it was difficult to realise that we were not in a South Staffordshire mine. There are, however, no gases evolved in stone as in coal mines, hence the air is much purer, and in these particular mines it is very good. The temperature stands at about 55° Fahr. all the year round, and so is specially suitable for physical labour, being neither too hot nor too cold.

On arrival at the entrance to the quarries all the men of our party, numbering about one hundred, were furnished with petroline hand lamps, all clean and freshly-trimmed, and provided new for the occasion by the kindness and consideration of the Bath Stone Firms, Limited. These made a fairly effective illumination, and enabled everything of interest in the galleries and chambers to be readily seen. The entrance is not by pit shafts as in most mines, but by inclined planes, more or less steep, the steeper ones flanked by steps. Down these are laid tramways to a 2ft. 6in. gauge, which traverse the whole of the workings. These tramlines enable the blocks of stone, when it is not necessary to keep them in the mine for a time for seasoning, to be placed at once on a trolley as soon as craned from their bed, and drawn direct from the mine to the wharf or railway station, and straightway loaded on to the railway truck.

The method of quarrying the stone is as follows:—The first thing to be done is to pick out close to the ceiling, or along the top of the uppermost layer of marketable stone, a horizontal groove from 6 to 12 inches in height, to the depth of, or running back from the face, about 5 feet, and extending the full width of the adit or working. This groove is holed with three successive picks. The first a large and heavy one with a short handle, the next a smaller pick with a longer handle, and, finally, a small light sharp pick with a handle which appeared to be some 6 or 7 feet in length, to enable the workman to work back to the full 5ft. This, after a little experience, the workman is readily able to do, as the stone, especially while *in situ*, is somewhat soft and friable. This admits of a saw being placed on edge in the groove, by means of which a man standing in front of the rock makes a vertical saw-cut at right angles to the groove down through the rock to the natural parting at the bottom of the first layer. This cut is in a right line from the front to the back of the groove. Another saw-cut is then made at a distance of about 5ft., but this is pointed in such a

direction that the block of stone which lies between the two cuts is narrower by about 6in. at the back than at the front. It is cut into this wedge shape so as to be more readily drawn out at the face of the rock by means of the crane. Wedges are now driven into the natural parting at the bottom of this taper piece of stone, until the stone is burst off at the back. It is then, sometimes by means of crowbars, prized forward sufficiently to admit of a chain being passed round the wide end of it, or more frequently, and as was the case with the block quarried in our presence, a lewis is inserted in the front of it. In either case the chain is attached to the crane, and the first piece of stone is thus drawn out from its position, and loaded on a trolley for removal as before described, leaving a hole in the rock large enough for a man to get into.

After the first block is out the work is easier. A man now goes to the far end of the hole, and, looking sideways, passes a saw into the groove, makes a vertical saw-cut down the back as well as down the remaining side ; thus the second piece of stone is detached on all sides as on the top, and easily drawn out from the rock. By a repetition of this process, and, of course, leaving sufficient pillars to carry the roof, the excavating of the upper beds is carried on to any extent.

The lower beds are detached by sawing only, there being no difficulty in starting a saw-cut on any of the surfaces. No explosives are used, the stone being soft enough, especially before it is seasoned, for everything to be done with pick, saw, and wedge. The saws used have large teeth, and are of a shape specially adapted for the work they have to perform, and are somewhat peculiar in appearance, having a long strong handle set at right angles to the saw.

The blocks of stone, as they are drawn out, are scappled to a proper shape, and all defective parts are removed. Each block is carefully inspected by at least two experienced foremen. The absence of metallic ring on its being struck by a hammer indicates an internal flaw, which has to be looked to and got rid of by cutting a large block into a smaller or into two smaller ones. Finally, every block is measured, marked, and numbered, then drawn by horse or steam power to the quarry mouth, and run down the tramways to the railway station.

To give some idea of the extent of these mines, we entered underground in Box Parish and emerged in Corsham Parish, having in the meantime traversed several miles of underground workings, occupying over two hours in doing so.

Though the Oolitic rocks stretch right across England from Dorsetshire to Yorkshire, it must not be supposed that Bath freestone is to be got all through the series. Good

workable stone is to be found only within an area of some thirty miles long by about ten miles broad, extending to the east of Bath between Chippenham on the north and Trowbridge on the south. The thickness of the stone also varies considerably. At Box Hill, where it is believed to reach its maximum, it is about 45ft., comprising 12ft. to 15ft. scallet or finest grained, cut for ashlar or facing purposes, 15ft. to 20ft. corn grit, used for dressings, and 16ft. to 22ft. ground stone; while at Combe Down, only a few miles distant, the total thickness is but about 7ft.

A characteristic of the stone may be mentioned: it is very light, its specific gravity when dry being but a shade over 2, while the generality of rocks forming the earth's crust average from 2½ to 3½ times the weight of water. One hundred pounds of dry stone will absorb only nine pounds of water, and a sound block will stand a pressure of seventy tons on the square foot without cracking.

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, M.A., AND J. E. BAGNALL, A.L.S.

(Continued from page 137.)

Sub-genus XXI.—Hebeloma.

214. **Ag. fastibilis**, *Fr.* Woods. Oct. The Spring; Crackley Wood, Kenilworth, *Russell, Illustr.* The Moats, Ansty, *Adams.* Sutton; Sutton Park; Trickley Coppice.
215. **Ag. testaceus**, *Batsch.* Rather rare. Sept.-Oct. Barnacle Lane, Combe, *Adams.* Hampton-in-Arden; Westwood Coppice, Sutton Park.
216. **Ag. versipellis**, *Fr.* Grassy spots in woods. Oct.-Nov. Combe Ridings, *Adams.* Sutton Park; Trickley Coppice.
217. **Ag. mesophæus**, *Fr.* Rare. Oct. Ansty, *Adams.* School Rough, Marston Green.
218. **Ag. sinapizans**, *Fr.* Damp woods. Sept. Alveston Pastures Wood, Sept., 1881.
219. **Ag. crustuliniformis**, *Bull.* Woods. Oct. Kenilworth, *Russell, List.* Ansty, *Adams.* Near Packington, in rings amongst grass.
220. **Ag. elatus**, *Batsch.* Rare. Sept. Knowle, *Hawkes!*
221. **Ag. longicaudus**, *Pers.* Woods. Rare. Oct. Brown's Wood, Solihull.

Sub-genus XXII.—Flammula.

222. **Ag. lentus.** *Pers.* On stumps. Oct. Foot of post, Dunn's Pits Lane, Kenilworth, *Russell, Illustr.* Combe, *Adams.* The Lyes, Kenilworth.

223. **Ag. gummosus,** *Lasch.* On stumps. Rare. Oct. Driffold Lane, Sutton.

224. **Ag. carbonarius,** *Fr.* Rare. On burnt earth, Sutton Park, Oct., 1884, *Dr. Cooke!* Combe Ridings, *Adams.*

225. **Ag. flavidus,** *Schæff.* On trunks of trees. Oct. Packington Park, *With.*, 205. Meadows, near Kenilworth, 1871; Kenilworth, 1876, *Russell, Illustr.* Ansty, *Adams.* Old Park Wood, near Alcester; Windley Pool, Sutton.

226. **Ag. conissans,** *Fr.* Oct. Rare. On willow trunks, Sutton Park, *Dr. Cooke, Illustr.*, pl. 445. Packington Park.

227. **Ag. inopus,** *Fr.* *Ag. connatus,* With. Lord Aylesford's Park, Packington! *With.*, 207. Coleshill Pool; Bradnock's Hayes; Trickley Coppice; Sutton Park.

Sub-genus XXIII.—Naucoria.

228. **Ag. cucumis,** *Pers.* Grassy places. Rare. On a lawn in a garden at Kenilworth, Oct., 1870. *Russell, Illustr.* Sutton Coldfield, Sept., 1888; Nov., 1888. "I agree entirely with those who consider this merely = *A. pisciodorus.*"—W. B. G.

229. **Ag. melinoides,** *Fr.* *Ag. lacrimalis,* With. Oct.-Dec. Edgbaston; Packington Park, *With.*, 244. Fields. Ansty, *Adams.* Field near Mr. Knowle's house and Dale House Lane, Kenilworth. *Russell, Illustr.* New Park; Sutton, etc.

230. **Ag. striæpes,** *Cooke.* Amongst grass, Ansty, Sept., *Adams!*

231. **Ag. sideroides,** *Bull.* Rare. Dunn's Pits Lane, Kenilworth, Oct., 1868, *Russell, Illustr.*

232. **Ag. pediades,** *Fr.* Pastures. Rare. Aug. Field opposite Orice Hill, Birmingham Road, Kenilworth, *Russell, Illustr.* Ansty, *Adams.* Bradnock's Marsh.

233. **Ag. semiorbicularis,** *Bull.* Pastures. Frequent. Aug.-Oct. The Cliff; The Spring, Kenilworth, *Russell, Illustr.* Mill Fields, Ansty, *Adams.* Sutton Park; Maxtoke Park; Kingsbury Wood; Fillongley, etc.

234. **Ag. sobrius,** *Fr.* Meadows. Oct.-Nov. Meadows, The Spring, Kenilworth, *Russell, Illustr.*

235. **Ag. erinaceus,** *Fr.* *Ag. lanatus,* Purt. March. At Pophills, on the dead branch of an oak, *Rev. W. S. Rufford,* in *Purt.*, iii., 211.

236. **Ag. conspersus,** *Pers.* Woods. Rare. Aug.-Sept. Crackley Wood, Kenilworth, *Russell, Illustr.* Hopsford, *Adams.*

237. **Ag. escharoides,** *Fr.* On the ground. Sept. Malthouse Lane, Kenilworth, *Russell, Illustr.* Hopsford, near Brinklow, *Adams.* Heathy waysides, near Coleshill Pool.

Sub-genus XXV.—Galera.

238. **Ag. lateritius,** *Fr.* *Ag. colus,* With. Pasture field, Edgbaston, Aug., 1792, *With.*, 276. Coughton, and pastures about Gorcot Hall, *Purt.*, ii., 650. On comparison of Sowerby's "upper figure," pointedly referred to by Withering, with the figures of *Ag. lateritius*, and noticing the "loose gills," its extreme fragility, and other distinctions which he draws, it is rendered probable, at least, that his *Ag. colus* is this species; whether the same may be said of Purton's, is not so sure. Withering was well acquainted with *Ag. tener*, which he describes exactly, p. 245; moreover, *Ag. lateritius* has the true "distaff" *(colus)* shape, which *Ag. tener* has not.

239. **Ag. tener,** *Schæff.* Plantations, gardens, amongst grass, etc. June-Oct. Edgbaston, amongst grass, *With.*, 245. Between the rows of asparagus beds (Alcester?); in a field at Oversley and Kinwarton, among grass, *Purt.*, iii., 221. Ansty, *Adams.* School Close, *Rugby Sch. Rep.* Sutton and Sutton Park; Edgbaston Park; Trickley Coppice; Olton; pine wood, near Coleshill Heath; Parley Park, near Atherstone; Marston Green, etc.

240. **Ag. ovalis,** *Fr.* Manure heaps. Aug. Manure heaps, Dunn's Pits Lane, Kenilworth, *Russell, Illustr.*

241. **Ag. antipus,** *Lasch.* On soil. Rare. On the bare soil of garden, Clarendon Villa, Kenilworth, *Russell, Illustr.*

242. **Ag. sparteus,** *Fr.* Amongst moss. Sept. Crackley Wood! Kenilworth, *Russell, Illustr.*

243. **Ag. rubiginosus,** *Pers.* Among moss. Barnacle Lane, Combe, *Adams.*

244. **Ag. hypnorum,** *Batsch.* On mossy banks. Not rare. Sep.-Oct. Kenilworth! *Russell, List.* Sutton Park; Trickley Coppice; Cut Throat Wood, Solihull; Crackley Wood, Kenilworth; New Park, Middleton; Langley, etc.

Var. *sphagnorum*, Pers. Sutton Park! Oct., 1888, *Dr. Cooke.* Cut Throat Wood, Solihull; Haywood; Hampton-in-Arden.

245. **Ag. mycenopsis,** *Fr.* Marshy ground. Oct. Olton Reservoir, Oct., 1881.

Sub-genus XXVI.—Tubaria.

246. **Ag. furfuraceus**, *Pers.* *Ag. circumseptus*, With. On chips in hedges, etc. Aug.-Oct. Edgbaston, in pasture lands, *With.*, 244. Crackley Wood, and garden near Kenilworth, *Russell*, *Illustr.* Fields, Ansty, *Adams.* Sutton; Trickley Coppice; New Park, Middleton; Olton; Marston Green; Coleshill Heath; Shustoke.

(To be continued.)

DESCRIPTIONS OF TWO NEW VARIETIES OF BRITISH SHELLS—*HELIX HISPIDA* VAR. *ELEVATA* AND *LIMNÆA PEREGRA* VAR. *CONVOLUTA*.

BY JOSEPH W. WILLIAMS.

The following two new varieties of shells which have come into my hands have, I believe, not been described as yet in either our home or Continental literature. They are both well-marked and interesting examples of the amount of change in structural conformation of shell to which some of our mollusca are liable.

Helix hispida var. *elevata.*—Width, 5 mill.; height, 4·5 mill. Shell small, brown, hispid. Spire flat, compressed, raised like a dais above the body-whorl; suture between the body-whorl and the adjacent whorl very deep, canaliculate; umbilicus very small; aperture sublunate. Looking at the shell from the aperture, it has, in some degree, the appearance of the shell of *Valvata piscinalis* (Müll), with the apical whorls of the spire depressed. Sent to the describer for the purpose of naming by Mr. A. E. Baker, of Leicester.

Locality.—Evington.

Limnæa peregra var. *convoluta.*—Length, 12 mill.; width, 12·5 mill.; length of aperture, 15 mill.; width, 11 mill. Shell small, ampullaceous, horn-colour, sculpture somewhat prominently plicate. Aperture suboval, patulous, convolute, quite concealing the spire; labrum inflected so as to become sulcate. Well marked on the outside of the shell with growth-varices. Collected by the author.

Locality.—Hillage Pool, Stourport, Worcestershire.

This variety somewhat reminds one in general form of what Hartmann, in 1842, described as *Gulnaria ampla*, now known as a variety of *Limnæa auricularia* (Linn.). It is, however, decidedly a form of *Limnæa peregra*, not taking into account the fact that *L. auricularia* does not occur in, or anywhere near, Hillage Pool.

35, Mitton, Stourport.

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS.

Name.	Date 1888.	Date 1888.	Aspect 1888.	Situation, &c. 1888.
Mercurialis perennis ..	Feb. 12	Dec. 9	S.W.	Hedge bank. Three female stems, with buds and foliage.
Ditto ditto ..		„ 26		Coppice. Male flowers plentiful, female rare.
		1889.	1889.	1889.
Poten. Fragariastrum ..	Apr. 15	Jan. 20	N.W.	Bank. Numerous flowers and ripe fruits.
Corylus Avellana ..	Jan. 29	„ 26	N.	Hill top. Female only
Tussilago Farfara ..	Mar. 3	„ 26	S.	One flower only
Cardamine hirsuta ..	„ 30	Mar. 9	S.W.	Brook side.
Petasites vulgaris ..	„ 4	„ 9	Open	Moist meadow. In 1888 only one plant in blossom, March 4th, which was cut off by frost. The plants generally were a fortnight earlier in 1889 than in 1888.
Helleborus viridis ..	Apr. 1	„ 10	W.	Moist meadow.
Ran. Ficaria	Mar. 30	„ 10	S.E.	Country orchard.
Anemone Pulsatilla ..		Apr. 1		Barton Hills. On Chalk; Mr. C. Crouch.
Caltha palustris.. ..	Apr. 13	„ 1	N.	Barton Spring. Mr. C. Crouch.
Anemone nemorosa ..	„ 15	„ 13	Open	Moist meadow.
Viola Reichenbachiana		„ 19	W.	Coppice.
Nepeta Glechoma ..	„ 28	„ 20	N.	Plantation.
Stellaria Holostea ..	May 12	„ 21	„	Hedge. One blossom.
Primula veris	Apr. 21	„ 21	W.	Meadow.
Prunus spinosa	„ 29	„ 27	Open	Hedge.
Cardamine pratensis ..	May 12	„ 27	„	Meadow.
Scilla nutans	„ 13	„ 27	S.	Coppice.
Galeobdolon luteum ..		May 4	W.	Hedgebank.
Sisym. Alliaria	„ 12	„ 4	„	Bank.
Ger. Robertianum ..	„ 21	„ 18	„	Bank. Plentiful.
Orchis Morio		„ 19	Open	Pasture.
Cratægus monogyna ..	„ 13	„ 23	N.	Hedge.

The unusually warm weather of the late autumn of 1888 brought on the plants of *Mercurialis perennis*, so that many of them had thrown up their vernal shoots early in December, and were in full blossom before the end of the year. With reference to *Tussilago Farfara*, observations have been continued in the same station since 1880, the date for each year being as follows:—1880, March 3rd; 1881, January 29th;

1882, January 25th; 1883, January 22nd; 1884, January 12th; 1885, February 8th; 1886, March 3rd; 1887, February 5th; 1888, March 3rd; 1889, January 26th.

JAS. SAUNDERS, Luton.

Wayside Note.

BALEA PERVERSA IN NOTTINGHAMSHIRE.—After seeing Mr. J. W. Williams, in London, and on my return to Nottingham, I referred to Mr. Musson's list and found that it contained several localities for *Balea perversa*, which are as follows:—"Recorded from Colwick, Highfield House (rare); Annesley (rare, old church wall). Plentiful under stones of church wall at Staunton. S.E. Notts. Plentiful under bark and in cracks of willow trees at Darleton, Notts, April 23rd, 1886."—GEO. W. MELLORS, Second Avenue, Sherwood Rise, Nottingham.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, July 16th. Mr. Chas. Pumphrey in the chair. Exhibition of specimens by Mr. Herbert Stone:—*Galeopsis versicolor*, *Drosera rotundifolia*, in flower; *Vaccinium oxycoccos*, in fruit; *Stratiotes aloides*, from Aspley, near Warrington; also, *Pholas crispatus* and *Tubularia indivisa*, from Hilbre Island, near Liverpool.—SOCIOLOGICAL SECTION, July 23rd. Mr. W. R. Hughes, F.L.S., in the chair. Mr. Martineau exhibited *Merisus intermedius*, a hymenopterous insect, parasitic upon the Hessian fly (*Cecidomyia destructor*). Mr. Hughes exhibited *Lythrum salicaria*, *Malva moschata*, *Geranium pratense*, *Campanula Trachelium*, *Cercis siliquastrum*, the Judas tree, *Melilotus officinalis*, *Reseda luteola*, and other plants from Evesham; also, *Verbascum nigrum*, from St. Albans.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 20th. Mr. J. W. Neville exhibited flowers of the Toothwort, *Lathræa squamaria;* Mr. H. Hawkes, *Puccinia sessilis* and *Stemonitis fusca;* Mr. Camm, *Physarum cinereum*, from a timber yard; Mr. J. Moore, gizzard of *Phyllobius argentatus;* Mr. Deakin, fish scales and teeth in carboniferous shale; Mr. Parker, quartz geode containing lead crystals.—May 27th. Mr. Camm exhibited the following fungi under the microscope:—*Lamproderma irideum*, *Tilmadoche mutabilis*, *Pachnocybe subulata*, and *Stemonitis fusca*, the latter from the plasmodium stage to the mature form. Mr. T. H. Waller, B.A., B.Sc., then gave a lecture on "Rowley Rag," in which he said that this being a local rock would give everyone an opportunity of studying it to the fullest extent. It formed a sheet of considerable extent, reaching from Rowley Regis to Dudley, and through it several shafts were sunk to get at the coal beds below. In Earl Dudley's pit 170 yards of basalt had to be bored through. There were two kinds of basalt, Roche and Bluestone; light veins were found in some specimens; these contained ten per cent. more silica. The texture of the rock varied immensely, one interesting feature being the sudden change of texture. The uncertainty of its cleavage appeared to depend on the normal jointing of the rock in the quarry. Its microscopic structure was described,

and the appearance of the crystals of felspar, augite, apatite, and olivine, and their order of crystallisation, and the transition of olivine in some rocks into serpentine. The solidification of a rock was a progressive process, and, though we begin with Rowley Rag, we find it so typical that we can get to almost any rock on the globe. The lecture was illustrated by a series of rock sections under the microscopes.—June 3rd. Mr. J. W. Neville exhibited slabs of Wenlock Limestone containing trilobites, &c.; Mr. J. Corbet, a series of the larger corals from the same formation; Mr. J. Moore, nine species of Zonites, and, under the microscope, palates of the same; Mr. H. Hawkes, a marine alga, *Ptilota plumosa*, in fruit.—June 17th. Mr. J. Madison showed specimens of *Limnæa truncatula*, *L. peregra*, *Neritina concava* and *Cochlicopa lubrica*, from the Eocene beds of Headon Hill; Mr. C. P. Neville, a specimen of spider crab; Mr. Corbet, lignite from the "fossil forest," Brook Point, Isle of Wight, and nodules of marcasite from the chalk; Mr. H. Hawkes, *Tilmadoche mutabilis;* Mr. Camm, *Sphæria ovina* and *S. hispida*.—June 24th. Mr. J. Moore gave a report of the Excursion to Salford Priors, and showed many varieties of *Helix nemoralis*, collected on the way; Mr. H. Hawkes showed a collection of plants and fungi from the same locality, among the latter was the Œcidium stage of *Puccinia phragmitis*. Mr. W. J. Parker then read a paper on "The Eyes." The writer said the eyes were most interesting, from the fact that they were the inlet of nearly all knowledge, and described the situation of the eyes, the structure of the crystalline lens, ciliary processes, choroid coat, retina and optic nerve, and showed that the eyes of the vertebrata differed but little from each other, except in minor ways. After comparing them with the eyes of insects and crustaceans, the writer referred to certain defects in vision, the most remarkable of which was "Daltonism," or colour blindness. The paper was illustrated by diagrams and microscopic slides.—July 1st. Mr. Linton exhibited a collection of fossils from the Portland beds; Mr. J. Collins *Spirogyra porticalis*, showing mature zygospores; Mr. A. Camm, *Trichia fallax* var. *minor*, a fungus on holly leaf.—July 8th. Mr. J. Madison exhibited a case of shells, showing varieties of *Unio*, *Anodon*, &c.; Mr. P. T. Deakin, two cases of shells, one of the smaller Helices, and the other of the Planorbis genus; Mr. J. Betteridge, specimens of Reed Warbler and Sedge Warbler, and three nests of the latter, showing a great variation in form; eggs of both birds were also shown; Mr. J. W. Neville, a number of specimens of Clausilia, from various foreign localities.—July 15th. Mr. J. Collins exhibited under the microscope, *Prasiola crispa*; Mr. J. Moore, gizzard of bee and wasp; Mr. Corbet, a collection of polished pebbles, agates and fossil corals, from Devonshire; Mr. J. Linton, a number of fossils from the Oxford clay, Peterborough. Mr. B. Cracroft then read a paper, "Notes on an Excursion to Cheddar," describing the journey from Weston-super-Mare, through several picturesque villages. The first appearance of the Cheddar rocks reflected in the sheet of water, collected from nine springs, was very imposing. At every step the scenery changes; the castellated form of some of the rocks being very striking. But the charm of the district was the caverns, where water oozed through every part, forming stalactites and stalagmites of singular form and beauty; and when we are told that thirty years had not added appreciably to them, some idea may be formed of the countless ages to which they owe their origin. The geological features of the rocks were referred to, and the rarer plants adorning them enumerated. The paper was illustrated by a series of photographs.

THE FIN WHALE FISHERY IN NORTH LAPLAND.*

BY H. BALFOUR, M.A., F.Z.S.

At the beginning of August last summer, in company with Mr. A. H. Cocks, I made a trip to the extreme North of Scandinavia. Our object, to a great extent, was to visit some of the whaling stations situated in North Finmarken or Norwegian Lapland. My friend had already visited these stations on several occasions, and has published a very interesting series of papers in the "Zoologist" (see list given at the end). Our journey across from Hull to Throndhjem did not produce any thing of special interest, though five whales were passed when about fifteen hours from the English coast. In the Throndhjem Museum one has the opportunity of studying many of the local Cetacea, of which several very well preserved specimens may be seen.

We left Throndhjem in one of the coasting mail steamers, which carried us as far as our destination, the little town of Vardö in East Finmarken; and, as the vessel had some seventy or more stations to call at on the way, in and out of the fjords and islands, we had ample opportunity for feasting our eyes upon the magnificent and varied coast scenery. The journey occupied a week. We saw several of the smaller Cetacea *en route*, chiefly dolphins of different species, and it was very interesting trying to identify these, though by no means easy, from the rapidity of their movements, and from the fact of more than one species associating together in "schools." One smaller species we identified frequently, *Delphinus Albirostris*, the "Springer" of the Norwegians. This species is characterised by its bold colouring of black and white in patches, its pure white beak, and very marked caudal keel. It springs very high out of the water when fishing, or sometimes apparently for the pure enjoyment of the thing; or possibly in the endeavour to shake off troublesome parasites.

Besides these, *D. tursio* appeared to be common, and on my return south, I met with the Pilot or Ca'aing Whale (*Globiocephalus melas*), in small "schools." Porpoises were fairly abundant in twos and threes, easily distinguished by the low and obtuse dorsal fin; occasionally might be seen a

* Read before the Oxfordshire Natural History Society, April 2nd, 1889.

"Killer" (*Orca gladiator*), with its extremely high, scythe-like dorsal fin and gleaming white belly. These could be seen feeding in company with "schools" of dolphins, and perhaps a Lesser Rorqual (*Balaenoptera rostrata*), following the shoals of herrings, the whole presenting a very busy scene. Flying over the water would be hundreds of gulls, and sometimes a pair of ospreys would "join the glad throng."

It was late in the season, and fewer Cetacea were to be seen than would have been the case a little earlier. During our journey east of the North Cape we saw no whales. The coast here is a "howling wilderness," a very "*βδέλυγμα τῆς ἐρημώσεως*," and the chief objects of interest, beyond the solemnly impressive coast line, were the various "Fugelbergs" or bird-cliffs, covered with close-packed thousands of gulls, kittiwakes chiefly, which present a marvellous sight. We reached the odoriferous little town of Vardö at the week's end, and found it looking extremely uninviting. Cod fishery is its principal industry, and it advertises this fact to an almost intolerable extent. The streets are paved with codfish heads and tails, with stacks of dried codfish everywhere, and acres of codfish hung on poles, drying to become "Stockfish," and emitting an effluvium better left undescribed. We went almost immediately down to the nearest whale "factory," to see if anything was going on. One's first instinctive impulse on reaching a whale factory, especially if there is a whale in process of demolition, is to turn round and retire again as fast as possible. There is an odour connected with these establishments which defies description. As soon, however, as one can subdue this prompting to flee, one rapidly becomes interested in the scene, and puts up with the horribly aromatic surroundings. On this occasion a common Rorqual was the centre of interest. To get close to a whale stranded at one of these factories, it is always necessary to manœuvre considerably, as the beach for hundreds of yards round a factory is covered along the high water mark with whale remains in various states of decomposition; bones, blubber, entrails, &c., about a foot or eighteen inches deep, the barrier being much too wide to jump, and not inviting any attempts in that direction, as a false step would be disastrous in the extreme. One must select a path across, and choose portions which seem more consistent than the rest, and so step over, the whole slippery mass quaking violently as you cross, and perhaps letting you in over your ankles in cetacean decomposition. Once across it is not so bad, though still you have to be careful not to slip on the smooth rocks, as you may thus be at any moment deposited in a pool not of salt water, but of

blood, which flows in great streams from the whale's body. These are the more unpleasant details, and I will not enlarge upon them further.

The town of Vardö is situated on a small island, and boasts of two whaling "factories," while others are built upon the mainland opposite. It is often difficult to cross over to the mainland, as the sound is frequently rough, and impassable to such cranky little tubs as one can borrow; though the waves *break* very little during the whaling season, because of the film of oil, escaped from the factories, which overlies the whole.

Besides the stations at Vardö we visited one at Yeretiki, on the Murman coast, to the north of the Kola Peninsula; but here, unfortunately, owing to the lateness of our arrival, no whales were brought in during our brief stay of two and a half days.

It may be well, before describing the methods of capture, &c., to give a brief account of the different species of "Fin Whales" which are the objects of pursuit in these regions.

The "Whalebone Whales" are divided into two groups: I. The *Balænidæ* or "Right Whales," including two northern species, the "Greenland Whale," and the "Atlantic" or "Biscayan Whale." These have no dorsal fin, the skin of the belly is smooth, the rostrum of the skull is compressed and rounded, and the rami of the lower jaw are strongly arched outwards, the baleen is very long, the flippers are short. The Greenland Whale averages 50ft. to 60ft. in length, the Biscayan somewhat less. II. The *Balænopteridæ*, including the "Humpbacked Whale," and the Rorquals or "Fin Whales." It is with these that I have to deal, as the whales regularly hunted off these coasts all belong to this group.

The group is divided into two genera:

A.—*Megaptera*, containing the species *M. boöps* frequenting these coasts. Norwegian, "Knöl."

B.—*Balænoptera*, including the following local species:

1.—*B. musculus*, the Common Rorqual or "Razorback," the "Fin hval" of the Norwegian whalers.

2.—*B. Sibbaldii*, Sibbald's Rorqual or "Blue Whale." Norwegian, "Blaa hval."

3.—*B. borealis*, Rudolphi's Rorqual. Norwegian, "Sej hval."

4.—*B. rostrata*, Lesser Rorqual. Norwegian, "Vaage hval."

Briefly, the characteristics of these species are as follows: *Megaptera boöps*, the "Humpback." Average length 45ft. to 50ft. Head large in proportion to body; tail broad; the flippers enormously long (often about 15ft.), narrow, serrated along the anterior margin, with large knobs along the edges; colour jet black above, and white mostly below, flippers usually for the most part gleaming white; baleen short and entirely black, the bristles forming the fringe short and coarse, and of a dirty brownish white; body stout and comparatively short; the pleats on the belly broad.

Balænoptera musculus, Common Rorqual. Average length 60ft. to 70ft, but often considerably more. Long and comparatively slender body; flippers very short; colour deep greyish slate above, white below, flippers rather lighter than the upper part; the pleats on the under surface narrower and more numerous than in the Humpback; baleen black on the outer edge, becoming slate colour towards the middle, and striped with yellow on the inside; bristles coarse, and light coloured, the plates short. (The name Rorqual is derived from the Norwegian "Rorq hval"= a whale with pleats or folds in the skin).

B. Sibbaldii, "Blue Whale," averages 60ft. to 80ft. in length, being the largest of the whale family. Head broad; flippers large; dorsal fin extremely low; robust build; colour deep bluish slate above, slightly paler below, no white except on underside of flippers; baleen jet glossy black, including the bristles; plates broad.

B. borealis, Rudolphi's Rorqual. Average length 35ft. to 45ft. Head broad; dorsal fin small, but comparatively higher than in *B. musculus*; flippers long and broad, pointed at the ends; colour black above, light colour below, flippers usually black on the outer and white on the inner surfaces; baleen black, with white bristles, these being of much finer texture than in the other species.

B. rostrata. As the Lesser Rorqual is not regularly hunted off these coasts, no particulars need be here given of this small species.

In habits these species differ slightly, though they seem for the most part to be governed by the same general instincts, and their movements and modes of living are to a very great extent the same. The range of the different species varies considerably. A difference is seen in their action in the water. In "sounding," that is diving straight downwards, the Humpback almost invariably disappears vertically, tossing the flukes of the tail high in the air; the Blue Whale

sometimes does, the other species rarely or never.* The Humpback, moreover, is the only northern species possessing a well-marked voice. This whale "screams" loudly when lanced. It is said that the Sperm Whale of the south also "gives tongue" when struck, and I have seen the same thing attributed to some species of dolphin. The other Rorquals are all silent, however much they may protest with their enormously powerful tails.

By September most of the whales have left these coasts, and the season is coming to a close. The Blue Whales are usually the first to go, but the others follow quickly, and the season ends somewhat abruptly.

The breeding habits of these whales are still but imperfectly known. It seems likely that pairing does not occur at any fixed period, while the period of gestation is probably a long one, usually more than a year. The newly born young is, roughly speaking, one-fourth the length of the mother. Thus a new-born Common Rorqual would be from 15ft. to 18ft. long, while the Blue Whale seems to give birth to proportionally larger offspring, 28ft. being no unusual size (a somewhat formidable progeny, one must admit !). The young of this species usually accompany the mother for a considerable time; they are frequently seen in company when the young is 50ft. long, and presumably "of age."

The chief food of the Fin Whales consists of herring, small cod, and capelan ("Lodde," Norwegian; *Mallotus arcticus*); also of large quantities of "Kril," *i.e.*, minute Crustacea (*Euphansia inermis*); and *Calanus Finmarchicus*. The *Euphansia inermis* are small thysanspod crustacea, about 1½in. long, and semi-transparent, frequently found in masses inside the jaws of a stranded whale, sticking to the fringe of the baleen. *Calanus Finmarchicus* is one of the Copepoda, of a bright reddish colour, also found in masses on the baleen. This is apparently the chief food of Rudolphi's Rorqual, which takes it in vast swarms near the surface.

Probably, besides those I have mentioned, many other animals provide food for these whales, such as Nudibranch Mollusca, Medusæ, and Pteropods, but traces of these are not easily found, as they are so rapidly digested.

There are various common forms of parasites, which infest the Balænopteridæ of Finmarken. Two of the commonest appear to be restricted to one only of the local species of Fin Whale, viz. the Humpback. These two parasites

* The Greenland Right Whale tosses its flukes in the air as a general custom, in the same manner as the Humpback.

are *Coronula diadema* and *Conchoderma auritum*, both belonging to the group Cirripedia, and allied to the barnacles. The Coronula occurs often in large masses on the Humpback, especially round the snout and on the flippers, the individuals being sometimes sunk deep into the dermis, and sometimes projecting like large warts.

The Right Whale of Greenland carries none of these Cirripedes, while its near ally the Biscayan Whale is usually infested with them; and the western whalers used to distinguish between whales without "calcareous plates" so called, these being the Greenland Whales, and those with "calcareous plates," the Biscayan Whales, or "Nord Kaper" as called by the Dutch and German whalers ("*Sarde*" *of the Basques*). The Humpback becomes early infested with these parasites; in fact, some whalers have affirmed that they are *born* with them, but such a case of "transmission of acquired character" is obviously highly improbable.

The *Conchoderma*, which somewhat resembles the common ship's barnacle (*Lepas anatifera*), is usually found attached to the shells of the Coronulæ, parasitic upon a parasite; or perhaps "symbiotic" more properly expresses this form of association. Almost every Humpback captured is infested with these two animals, sometimes to a marvellous extent.

The third common parasite is a Cyamus, or "Whale Louse;" this enjoys a free moving existence on the whales, either upon the surface, or burrowing a short distance below. A small Copepod is commonly found upon the baleen plates of the Blue Whale, and appears to be restricted to this species, unless we except Rudolphi's Rorqual perhaps. It was described by Herr Aurivilius, of Upsala, and named *Balænophilus unisetus* (*nov. gen. et sp.*).*

Various Entozoa occur, Echinorhynchi being most commonly met with, especially in Rudolphi's Rorqual.

I have given but a brief sketch of the natural history of these whales, as I wish now to turn to the question of their capture and conversion into merchandise.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 186.)

LEES, IN "BOTANY OF THE MALVERN HILLS."

* **Typha angustifolia**, 48. Abundant at New Pool, Malvern Chace. Ill.

* V., P. Z. S., 1886.

* **Sparganium natans**, 48. (*S. minimum in 3rd Edition.*) From a muddy pool at Cotheridge. From the late John Walcot, Esq. *A true record for Sparganium minimum.* Ill. *See ante, "Midland Naturalist," Vol. XI., p. 206.*

Lemna minor, 43.

* **Potamogeton natans**, 45. Ill.

† **P. lanceolatus**, 45. An error. Omitted in the 2nd and 3rd Editions.

P. perfoliatus, 45.

P. crispus, 45.

P. gramineus, 45. *P. obtusifolius (P. gramineus Sm.) is probably intended here.*

P. pusillus, recorded from Kempsey Ford in the Ill. is omitted in the 1st and 2nd Editions, but noted in the 3rd as growing in a pool on Barnard's Green.

* **P. pectinatus**, 45. Ill.

* **Zannichellia palustris**, 47. Pools on Welland Common.

* **Triglochin palustre**, 46. Ill.

* **Alisma Plantago**, 46. Ill.

* **Butomus umbellatus**, 47. Castle Morton, bordering on Longdon Marsh. Ill.

* **Hydrocharis Morsus-ranæ**, 48. Pools. E. Ill.

* **Orchis pyramidalis**, 47. Ill.

* **O. ustulata**, 47.

O. morio, 47.

O. mascula, 47.

* **O. latifolia**, 47.

* **O. maculata**, 47.

* **Gymnadenia conopsea**, 47. Ill.

* **Habenaria viridis**, 47. Ill.

* **H. chlorantha**, 47. Woods on the Limestone. *Ill. as O. bifolia.*

H. bifolia, 47. Open pastures. E. and W. Ill.

* **Ophrys apifera**, 47. About the vicinity of the Croft and Leigh Sinton Lime Works. Ill.

* **Neottia spiralis**, 47. (*Spiranthes autumnalis.*) Ill.

* **Listera ovata**, 47.

* **L.** (*Neottia*) **Nidus-avis**, 47. Ill.

* **Epipactis latifolia**, 47. In most of the western woods.

* **Iris fœtidissima**, 48. Ill.

I. Pseudacorus, 43.

* **Narcissus Pseudo-narcissus**, 46. In New's Wood, and several others about Little Malvern. Ill.

* **N. biflorus**, 46. In orchards at the Berrow. Ill.

‡ * **Galanthus nivalis**, 46. In a little meadow at the northern base of the Herefordshire Beacon. Ill. *In the County of Hereford.*

* **Tamus communis**, 48.

* **Paris quadrifolia**, 46. In most of the shady woods on both sides of the hills. Ill.

* **Tulipa sylvestris**, 46. In an abandoned limestone quarry at Mathon. Ill.

* **Allium vineale**, 46. Borders of the fields about Malvern Wells and Hanley. Ill.

* **A. oleraceum**, 46. Rare. E. Ill.

* **A. ursinum**, 46. Moist woods. Ill.

* **Colchicum autumnale**, 46. E. and W. Ill.

* **Luzula Fosteri**, 46.

L. pilosa, 46.

* **L. sylvatica**, 46.

* **L. campestris**, 46.

* **L. congesta** (*multiflora*), 46. Ill.

* **Juncus conglomeratus**, 46.

* **J. effusus**, 46.

J. acutiflorus, 46.

* **J. lamprocarpus**, 46.

* **J. uliginosus** (*supinus*), 46. Ill.

J. compressus.

* **J. bufonius**, 46.

Juncus glaucus is not recorded in the 1st Edition.

Blysmus compressus, 44. Abundant on the margin of springy spots on the hills, especially about the Wells.

* **Eleocharis palustris**, 44.

E. multicaulis, 44. *In the 2nd and 3rd Editions the locality given is: "Marshy spots on Castle Morton Common." I have never seen this plant in the Malvern district, and think it possible that the next species may have been mistaken for it.*

Scirpus pauciflorus, 44. *In the 2nd and 3rd Editions, same locality as the last. See Scott, "Midland Naturalist," Vol. XI., p. 40.*

* † **S. cæspitosus**. 44. *Probably an error. Not noticed in the 2nd and 3rd Editions.*

S. fluitans, 43. Pools. E.

* **S. setaceus**, 43. E.

* **S. maritimus**, 44. In several ditches about Longdon Marsh.

* **S. sylvaticus**, 44. Chalybeate Pool. Ill.

‡ **Eriophorum pubescens** (*latifolium*), 44. On the Colwall side of the hills. *Hereford.*

* **E. polystachion** (*angustifolium*), 44. Bog on the western base of the Worcestershire Beacon. Ill.

† **Elyna** (*Kobresia*) **caricina**. Side of New Pool near Wood Farm. *Not noted in 3rd Edition, nor in "Botany of Worcestershire." Must be an error.*

Carex. *Of this genus thirty-three species are noted. Among them are the following:—*

* **C. dioica**, 48. (*In the 3rd Edition the localities given are: "Bog near Keysend Hill; also in a boggy place on the declivity of the Worcestershire Beacon." "Specimens are preserved in the Herbarium of the Worcestershire Natural History Society, gathered by Mr. George Reece, the assiduous curator."*

† **C. teretiuscula**, 48. *Probably an error.* Not in the 2nd or 3rd Editions. *See Scott, "Midland Naturalist," Vol. XI., p. 40.*

C. ovalis var. **bracteata**, 48. On the common below Malvern Wells.

† **C. stricta**, 48. Probably an error. *See Scott, "Midland Naturalist," Vol. XI., p. 41.*

* **C. recurva** *(glauca)*, 48.

† **C. limosa**, 48. *Not in 2nd or 3rd Editions. An error. See Scott, "Midland Naturalist," Vol. XI., p. 41.*

* **C. distans**, 48. *Locality in 3rd Edition, Longdon Marsh.*

* (?) **C. paludosa**, 48. *See Miss Beilby, "Midland Naturalist," Vol. XI., p. 307.*

Alopecurus pratensis, 44.

Phleum pratense, 45. *Var. nodosum recorded by Scott.*

Gastridium lendigerum, 45. Sarn Hill, near Longdon.

Agrostis canina, 45.

* **Calamagrostis Epigejos**, 45. Filling a wet field at the Berrow. Ill.

* **Arundo Phragmites**, 45. Abundant in Longdon Marsh. Ill.

Aira cæspitosa, 45.

* **A.** (*Kœleria*) **cristata**, 45. *In 2nd and 3rd Editions. On Raggedstone Hill, Worcestershire.* Ill.

* **Avena flavescens**, 45.

* **Av. pratensis**, 45.

* **Av. fatua**, 45.

* **Triodia decumbens**, 45. Beacon. Malvern Chace.

* **Poa** (*Schlerochloa*) **rigida**, 45. Ill.

* **P.** (*Glyceria*) **aquatica**, 45. Ill.

* **P.** (*Glyceria*) **fluitans**, 45.

P. annua, 45.

P. compressa, 45.

* **P. nemoralis**, 45.

† **Briza minor** ? 45. *An error. In the 2nd and 3rd Editions this is called B. media var. abortiva, with the locality, "Bog at the base of the Worcestershire Beacon." See Scott, "Midland Naturalist," Vol. XI., p. 42.*

B. media, 45.

* **Festuca bromoides** (*sciuroides, Roth.*) 45.

* **F. Myurus**, 45.

* **F. elatior**, 45.

* **F. pratensis**, 45.

* **F. loliacea**, 45.

* **Bromus giganteus**, 45.

* **Br. erectus**, 45.

* **Br. secalinus**, 45.

* **Br. racemosus**, 45. Ill.

* **Brachypodium sylvaticum**, 45. Ill.
* **Brach. pinnatum**, 45. Ill.
* **Triticum caninum**, 45.
* **Lolium temulentum**, 45.
* **Elymus europæus** (*Hordeum sylvaticum*, Huds.). In several of the western woods.
* **Hordeum pratense**, 45.
* **Nardus stricta**, 45. Ill.
* **Pteris aquilina**, 50.

Allosorus crispus, 50. In a fissure of a crumbling rock on one of the eastern buttresses of the Herefordshire Beacon, above the Priory Farm, Little Malvern, Worcestershire. Extinct?

* **Blechnum boreale**, 50. On boggy ground about the hills. Ill.
* **Asplenium Ruta-muraria**, 50. Ill.
* **Asp. Trichomanes**, 50. In crevices among the shady rocks of the hills.
* **Asp. viride**, 50. Ham Bridge. Ill. *See ante, "Midland Naturalist," Vol. XI., p. 223. Extinct.*
* **Asp. Adiantum-nigrum**, 50. Common on the rocks. Ill.
* **Athyrium Filix-fœmina**, 51. Ill.
* **Ath. irriguum**, 52. Bog on western base of Worcestershire Beacon. Var. of preceding. Ill.
* **Grammitis Ceterach**, *Ceterach officinarum*, 52. Ill. On a lofty stone wall, close to the road at Great Malvern, near the entrance of Holly Lodge. *Extinct in this locality, see 3rd Edition, which see also for other habitats.*
* **Scolopendrium vulgare**, 52. Common.
* **Aspidium aculeatum**, 51. Ill.
* and var. **lobatum**, 51. Ill.
* **Asp. angulare**, 51. Ill.

Lastræa Filix-mas, 51.

† **L. cristata**, 51. In Crow's Nest Wood, between Worcester and Cotheridge, according to the Herbarium of the late Mr. T. Stretch, of Worcester. *An error, not in 2nd nor in 3rd Editions. See Miss Beilby, "Midland Naturalist," Vol. XI., p. 307.*

* **L. spinulosa**, 51. Ill.
* **L. dilatata**, 51. Ill.
* **L. Oreopteris**, 51. Ill.
* **Polypodium vulgare**, 50. Ill.
* **P. Dryopteris**, 50. Ill. } *See ante, "Midland Naturalist," Vol. XI., p. 224.*

† **P. calcareum**, 50. Ill. *An error.* }

* **Ophioglossum vulgatum**, 50. Abundant on the southern side of Longdon Marsh; also in Grimley Meadows near Worcester, Mr. A. Edmunds. 2nd Edition, 1887; on the turf near the entrance of Purlieu Lane, 1850. 3rd Edition; in a field near the new church, Malvern Link.
* **Chara flexilis**, 49. In great abundance in pools on Castle Morton Common.

C. vulgaris. Pools and bog holes.

C. hispida. Ditches of Longdon Marsh.

N.B.—**Cnicus arvensis**, 38. *First record is omitted from page 162.*

(To be continued.)

XIII

THE LAND AND FRESH WATER MOLLUSCA OF NORTH STAFFORDSHIRE.

COMPILED BY JOHN R. B. MASEFIELD, M.A.

NOTE.—The initials of the authorities quoted refer as follows:—

L. E. A.—Mr. Lionel E. Adams, B.A., Penistone.
J. R. B. M.—Mr. John R. B. Masefield, M.A., Rosehill, Cheadle, Staffordshire.
E. D. B.—Mr. Edwin D. Bostock, The Radfords, Stone.
T. F. B.—Mr. Thos. F. Burrows, Daisy Bank, Cheadle.
F. B. W.—Mr. Fred. B. Webb, Stafford.

AQUATIC.

CONCHIFERA.

SPHERIIDÆ.

SPHÆRIUM.

1.—Sphærium corneum	Common everywhere.
,, v. flavescens	Canals, Stone (J. R. B. M.), Stafford (F. B. W.)
,, v. nucleus	Canal, Barlaston (J. R. B. M.)
2. ,, rivicola	Common, all canals and rivers.
3. ,, ovale	Froghall Canal, very fine (J.R.B.M.) Stoke-on-Trent Canal (F. B. W.)
4. ,, lacustre	Stafford (F. B. W.)
,, v. Brochoniana	Ditto

PISIDIUM.

5.—Pisidium amnicum	Canals, common.
6.— ,, fontinale	On duckweed in ponds, fairly common.
7.— ,, nitidum	River, Stafford (F. B. W.), Colwich (J. R. B. M.)

UNIONIDÆ.

UNIO.

8.—Unio tumidus	In all large pools, meres and canals.
,, ,, v. radiata	Canal, Colwich (J. R. B. M.)
,, ,, v. richensis	Copmere (J. R. B. M.)
9. ,, pictorum	Large pools, meres and canals.
,, ,, v. longirostris	Copmere (J. R. B. M.), Canal, Colwich (F.B.W.), also var. with rich salmon nacre (J. R. B. M.)

ANODONTA.

10.—Anodonta cygnea	Same localities as Unios, very large, in pool, Aston, Stone.
,, ,, v. radiata	Stone Canal (J. R. B. M.)
,, ,, v. incrassata	Hales Hall Pool, Cheadle (J.R.B.M.)
,, ,, v. Zellensis ,, ,, v. pallida ,, ,, v. rostrata	Copmere (J. R. B. M.)
11. ,, anatina	Same localities as last.
,, ,, v. major ,, ,, v. radiata	Canal, Colwich (J. R. B. M.)

DREISSENIDÆ.
DREISSENA.

12.—Dreissena polymorpha	Walls of Canal, Colwich, very fine, with a variety, with a white line down the centre of each valve (J. R. B. M.), Stafford (F. B. W.)

GASTEROPODA.
NERITIDÆ.
NERITINA.

13.—Neritina fluviatilis	Canal, Colwich (J. R. B. M.)
,, ,, v. cerina	Ditto Milford (L. E. A.)

PALUDINIDÆ.
PALUDINA.

14.—Paludina vivipara	Canals everywhere.

BYTHINIA.

15.—Bythinia tentaculata	Common all canals and rivers.
,, ,, v. producta ,, ,, v. zonata	River Sow, Stafford (L. E. A.)
,, ,, m. decollatum	Stone Canal (J. R. B. M.), Stafford (L. E. A.)
16. ,, Leachii	Ditto, Canal, Haywood (L. E. A.)

VALVATIDÆ.
VALVATA.

17.—Valvata piscinalis	Canal, Stone, Froghall and river Colwich (J. R. B. M.)
,, ,, v. acuminata	Stafford (L. A. A.)
18. ,, cristata	Stafford (F. B. W.)

LIMNÆIDÆ.
PLANORBIS.

19.—Planorbis nitidus	Stafford (E. D. B.), Canal, Oakamoor (T. F. B.)
20. ,, nautileus	Maer Pool (J. R. B. M.), Stafford (L. E. A.)
21. ,, albus	Pools and streams generally.
22. ,, spirorbis	Stafford, Stone (F. B. W.), Froghall (T. F. B.)
23. ,, vortex	Ditto, very common,
24. ,, carinatus	Fairly common, canals, &c.
25. ,, complanatus	Very common.
26. ,, corneus	Local—Canal, Stone (J. R. B. M.), River Sow, Stafford (L. E. A.)
27. ,, contortus	Canal and river, Stafford, Newcastle, Froghall (T. F. B.)

PHYSA.

28.—Physa hypnorum	Stafford (L. E. A.) Burton-on-Trent (Dr. Mason.)
29. ,, fontinalis	On weed in running streams.
,, ,, v. inflata	Cheadle (J. R. B. M.), river, Stafford (E. D. B.)
,, v. curta	Stafford (L. E. A.

LIMNEA.

30.—	Limnea peregra	Common in every ditch and pool.
,,	,, v. ovata	Cheadle (J. R. B. M.), river, Stafford (F. B. W.)
,,	,, v. ampulacea	Cheadle, very fine (J. R. B. M.)
,,	,, v. picta	Ditto, one specimen.
,,	,, m. decollatum	Ditto.
31.	,, auricularia	Stafford (F. B. W.), Cheadle and Colwich (J. R. B. M.)
,,	,, v. albida	Colwich Canal one specimen (J. R. B. M.)
32.	,, stagnalis	Barlaston pools and canals, Stone, very fine (J. R. B. M.), Stafford (F. B. W.)
,,	,, v. albida	Pool, Cannock Chase (L. E. A.)
,,	,, v. labiata	Stafford (L. E. A.)
33.	,, palustris	Ditches in meadows generally.
34.	,, truncatula	Ditto.
35.	,, glabra	
,,	,, v. elongata	Canal, Stoke (F. B. W.), ponds near Cheadle—fine (T. F. B.)
,,	,, m. decollatum	

ANCYLUS.

36.—	Ancylus fluviatilis	Common on stones in streams.
,,	,, v. capuloides	Stafford—very large (F. B. W.)
,,	,, v. albida	Cannock Chase (J. R. B. M.)
,,	,, v. stricta	Stafford (L. E. A.)
37.	,, lacustris	Common—ponds and pools.
,,	,, v. compressa	
,,	,, v. Moquiniana	Canal, Colwich—local (L. E. A.)
,,	,, v. albida	

TERRESTRIAL.

ARIONIDÆ.

ARION.

38.—	Arion ater	Common.
,,	,, v. rufa	Rosehill, Cheadle (J. R. B. M.)
,,	,, v. albolateralis	Stafford, one specimen (L. E. A.)
,,	,, v. brunea	Barlaston (J. R. B. M.)
,,	,, v. nigrescens	Stafford (L. E. A.)
39.	,, hortensis	Common in gardens.
40.	,, Bourginati	Cheadle (F.B.W.), Stafford (L.E.A.)
41.	,, subfuscus	Ditto.
,,	,, v. aurantiaca	Stafford (L. E. A.)

LIMACIDÆ.

AMALIA.

42.—	Amalia gagates v. plumbea	Stafford (L. E. A.)
43.	,, marginata	Stone (J. R. B. M.)

LIMAX.

44.—	Limax maximus	Common in cellars—one specimen 6½in. in length (J. R. B. M.)
,,	,, v. cinerea	Stafford (L. E. A.)
,,	,, v. Johnstoni	
,,	,, v. fasciata	Cheadle (J. R. B. M.)
45.	,, flavus	Cheadle (J.R.B.M.). Stone (E.D.B.)
,,	v. griscea	Stafford (L. E. A.)

46.—Limax cinereo-niger v. maura	Ditto.
,, v. luctuosa	
47. ,, agrestris	Very common everywhere.
,, ,, v. nigra	Stafford (L. E. A.)
,, ,, v. lilacina	
,, ,, v. sylvatica	
,, ,, v. albida	Cheadle (J. R. B. M.)
48. ,, lævis	Stafford (L. E. A.)
49. ,, arborum	Cheadle (J. R. B. M.), Stafford (L. E. A.)

HELICIDÆ.

SUCCINEA.

50.—Succinea putris	On flags and reeds by canals.
51. ,, elegans	Stafford (L.E.A.), Stone (E.D.B.)—one specimen.

VITRINA.

52.—Vitrina pellucida	Common under stones everywhere.

ZONITES.

53.—Zonites cellarius	Ditto.
,, ,, v. albinos	Cheadle (J. R. B. M.), Stafford (L. E. A.)
54. ,, alliarius	Under decayed wood and stones.
,, ,, v. viridula	Cauldon (T. F. B.)
55. ,, glaber	Stafford (L. E. A.), Weaver Hills (T. F. B.)
56. ,, nitidulus	Common under leaves, stones, &c.
57. ,, purus	Cheadle (J.R.B.M.), Stone (E.D.B.)
,, ,, v. margaritacea	Cheadle (J. R. B. M.)
58. ,, radiatulus	Cheadle, fairly common (J.R.B.M.)
,, ,, v. viridescenti-alba	High Shut, Cheadle (T. F. B.)
59. ,, excavatus	Byrth Hill, Maer (J. R. B. M.)
60. ,, nitidus	Stafford (L. E. A.)
61. ,, crystallinus	Common, Cheadle (J.R.B.M.), very fine, Cauldon (T. F. B.)
62. ,, fulvus	Cheadle, local (J.R.B.M.), Stafford (F. B. W.)

HELIX.

63.—Helix aculeata	Cheadle, Leek, Grindon (J.R.B.M.)
64. ,, aspersa	Stafford, rare and Colwich, local (L. E. A.)—not further north in county.
65. ,, nemoralis	Common in hedgerows and especially on the limestone (J. R. B. M.)
,, ,, v. libellula	Ditto
,, ,, v. albolabiata	Ditto
,, ,, v. roseolabiata	Ditto
,, ,, v. rubella	Ditto
,, ,, v. castanea	Abundant in Dovedale (J. R. B. M.)
66. ,, hortensis	Fairly common in gardens.
,, ,, v. lutea	Stone.
67. ,, arbustorum	Local, Cheadle (J. R. B. M.)
,, ,, v. alpestris	Grindon (F. B. W.)
,, ,, v. pallida	Ditto and Dovedale (E. D. B.)
,, ,, v. flavescens	Cheadle (T. F. B.)
,, ,, v. cincta	Grindon (T. F. B.)

68.—Helix rufescens	Stafford (L.E.A.), Grindon (F.B.W.)
,, ,, v. rubens	Froghall (T. F. B.)
,, ,, v. albida	Grindon (F. B. W.)
69. ,, concinna	Common under stones, &c.
,, ,, v. albida	Grindon (F. B. W.), Weaver Hills (T. F. B.)
70. ,, hispida	Common at foot of walls, &c.
,, ,, v. albida	Cheadle (J. R. B. M.)
71. ,, caperata	Weaver Hills (J. R. B. M.)
72. ,, virgata	Grindon (F. B. W.)
73. ,, ericetorum	Grindon(F.B.W.)Dovedale(J.R.B.M)
,, ,, v. griceseens.	Near Dovedale (T. F. B.)
74. ,, rotundata	Common under stones and bark.
,, ,, v. albida	Cheadle—one specimen (J. R. B. M.)
75. ,, rupestris	Common on limestone.
76. ,, pygmea	Cheadle (T. F. B.), Stafford (L.E.A.)
77. ,, pulchella	Common on limestone.
,, ,, v. costata	Grindon (F. B. W.)
78. ,, lapicida	Dovedale (J. R. B. M.)

BULIMUS.

79.—Bulimus obscurus	Cheadle, Stafford, &c.
,, ,, v. albinos	Weaver Hills (J. R. B. M.)

PUPA.

80.—Pupa secale	Grindon (F. B. W.)
81. ,, umbilicata	Stafford, Cheadle, &c.
82. ,, marginata	Grindon (F. B. W.)

VERTIGO.

83.—Vertigo pygmea	Grindon (F. B. W.)
84. ,, substriata	Leek (J. R. B. M.)
85. ,, edentula	Cheadle, Leek (J.R.B.M.), Stafford (L. E. A.)
,, ,, v. columella	Cheadle (J. R. B. M.)

BALEA.

86.—Balea perversa	Cauldon (T. F. B.), Ramsor (J. R. B. M.)

CLAUSILIA.

87.—Clausilia rugosa	Common on rocks and walls.
,, ,, v. dubia	Stone (E. D. B.)
88. ,, laminata	Stone, Stafford, Cauldon.
,, ,, v. albinos	Grindon (F. B. W.)

COCHLICOPA.

89.—Cochlicopa lubrica	Common amongst dead leaves (J. R. B. M.)
,, ,, v. lubricoides	Stafford (F. B. W.)
90. ,, tridens	Ilam (T. F. B.)

ACHATINA.

91.—Achatina acicula	Grindon (F. B. W.), Dovedale (T. F. B.)

CARYCHIUM.

92.—Carychium minimum	Cheadle (J. R. B. M.), Stafford (L. E. A.)

In Mr. Garner's "History of Staffordshire," he includes the following species, but these have not been met with in recent years :—

"Helix cantiana—not rare in Dovedale and Wetton Valley."
"Helix fusca—Stoke-on-Trent; dell at Oakamoor."
"Helix lamellata—among leaves in a valley at Oakamoor; only three specimens found in October living: Mr. Carter."
"Succinea oblonga—Staffordshire; Birmingham Museum."
"Clausilia biplicata—Alton Castle; Mr. Carter."
"Limnea glutinosa—common, Stoke-on-Trent."
"Planorbis lævis (glaber)—occasional in pools."
"Planorbis lineatus—canals, Stoke."
"Paludina contecta—canals."
"Pisidium obtusale (pusillum)—frequent, Betley Pool."

THE POCKET DREDGE.

BY E. W. BURGESS.

Having many times been much put about when travelling on the seas, and for the purpose of dredging having to make use of zinc-pans, or tinned-meat cans loaded with the log-lead to weight the article used, and the log-line to draw it up to the vessel, I have found much inconvenience in the use of such utensils; and hearing that Mr. David Robertson, of Millport, Scotland, had made a dredge 7in. wide, I thought I would also try to do the same. Therefore I wrote to Mr. W. P. Marshall to get the particulars of the Birmingham Natural History Society's dredges; and he gave me a sketch of the smallest of these to scale, with a few hints about making it. But as I had great trouble in having one made by the blacksmith I applied to, I gave him up and tried another way, by making a model in wood, and getting it cast in brass. I drilled holes in each side to join the head to the bag with copper-wire, and also curved the bars connecting the scrapers, so that the scraping edge should be wider than the inside, and used sacking-canvas for the bag 12in. long, and connected the head to the dredge-rope by two wire handles.

The line attached to the dredge was a strong water-line ¼in. in diameter, nearly the thickness of a black-lead pencil, marked in six-feet lengths (fathoms), each five fathoms in similar coloured worsted or a combination of colours twisted through the strands—such as, the first five fathoms red; the next five yellow, &c.—for the convenience of counting the depth of the water dredged.

I found at times a little trouble; the bottom was very rocky, the dredge getting fast and requiring the boat to return over the dredge to free it. In using the dredge, I had a piece of wire-rope nearly the same size as the other, and 4ft. long, attached to the dredge, and at the end furthest from the

dredge a lead weight of 3lb. fastened at the junction of the wire-rope and the marked cord. Also an ordinary wooden cross-frame for winding the cord upon. I used the dredge, as thus made, and found it work very well, except that the bag required altering.

On showing it to a gentleman who has done a great deal of dredging in all parts of the world (Government work, &c.), he advised me to try chains attached to the bars. I tried the chains, and went out dredging. The water was very rough for the small boat I was in, and the dredge would not act, so I altered it back to the wire handles as formerly, and tried a fresh bag made to open at the lower end, and longer, being 24in long. This I found to act splendidly.

Being open at the end, it required tying in a bunch about 2in. from the end; and on bringing it up full, I untied the end, and dropped its contents out into a coarse sieve of ⅛in. mesh, lying within a finer one to retain sand and foraminifera, and yet allowing the finer mud to be washed out by agitating the sieve in the sea. The sieve should first be tied to the boat, as I had one knocked out of my hand, and lost it, being metal, in the depths below.

In the coarsest sieve were found brittle-stars, stones, algæ, viz., *Melobesia calcarea*; and hydroids, as *Sertularius*, *&c.* If possible, a vessel, such as a baling can, might be used in the boat to wash and separate many foraminifera, by putting a portion of the sand or mud in it with water, and giving a rapid circular motion to its contents; then, on pouring the water through the finest sieve immediately the sand begins to settle, we retain the forms that will float; always keep some of the mud unwashed, to wash at leisure at home. Then look carefully over the residue for such forms as *Astrortriza limisola*, *&c.* This procedure enables one to carry away less waste material.

Again, the bag can be made of different materials, according to the character of the objects dredged for; such as an outside bag of open canvas, and an interior bag of silk gauze, which will allow free egress to the water, but retain the objects desired. A small pocket, drawn together by a cord, at the entrance of the bag, made on the principle of an eel or lobster-trap, will retain the objects in case the dredge is inverted.

These few remarks I have made, thinking that some of the members of the Birmingham Natural History and Microscopical Society might like to have such an object as a pocket dredge. As to cost, weight, &c.: Cord, 50ft., 5s.; making of dredge, under 5s.; weight of ditto, 3lb. 2oz.; lead, 3lb.; total weight, cord, dredge, and lead, 9lb. 2oz.

THE PETROLOGY OF OUR LOCAL PEBBLES.

BY T. H. WALLER, B.A., B.SC.

(Continued from page 178.)

(2) A white quartzite (2) from Sutton.

The component grains are more rounded than is the case in (1), but still they must be called subangular. They are of about the same average dimensions as those in the last specimen, but a quartz vein cuts across the section, and in it the "mosaic" is on a good deal larger scale.

This pebble also contains a considerable quantity of what appears to be a decomposed felspar; the edges of the fragments are only just rounded off, to no greater degree than the quartz grains. One grain was observed showing the cross hatched extinction pattern of microcline.

A good many zircons and tourmalines of considerable size lie among the quartz grains, but not in them; unless one crystal of which the exact form could not be distinguished, but which possessed a high double refraction, may have been a zircon. Some bodies of high refractive index, as shown by the solid appearance they had in the quartz, appeared isotropic, and seemed to have crystal faces, but the shape could not be made out. There is also a number of grains of a colourless, or very faintly yellow, mineral, apparently decomposed, along cracks, which stands out in decidedly greater relief than the quartz grains and does not appear to have the secondary quartz grown to it.

(3) A yellowish white quartzite (4), from Sutton. This pebble contained lingula.

The quartz grains are small, from ·005 to ·003 of an inch. They are slightly rounded, and the cementing quartz is in optical continuity with them. A few flakes of white mica and a few grains of felspar are mixed with the quartz, but the most noticeable feature is the very great richness in zircon and rutile, especially the former. In one field of $\frac{1}{20}$ inch diameter I counted ten rounded grains of zircon and two or three of rutile. They appear to have been loose in the sand from which the quartzite had been compacted.

A small quantity of this quartzite was treated with hydrofluoric acid, and the grains which were left collected by subsidence. They are, as the slide shows, zircons and a few rutiles. In the solution, after evaporation to get rid of the silica, titanic acid and zirconia could be easily detected;

but it did not seem worth while to undertake the very awkward quantitative separation of these oxides, especially as such a large quantity of mineral had escaped solution.

(4) A light quartzite (18), with dark bands about $\frac{1}{30}$ inch wide, and at distances of from three to five-sixteenths of an inch. This pebble was obtained from a stoneheap by the roadside between Alvecurch and Blackwell, so that the exact place in the beds is uncertain.

It is composed of somewhat angular quartz grains, many somewhat rectangular in shape, and in parts of the section these appear to lie with the longer dimension of the rectangle across the direction of the banding, so that, neglecting the banding which, under the microscope, is not very obtrusive, the impression is certainly of the bedding being at right angles or thereabouts to the bands. The dark bands are produced by black cloudy grains of quartz and by a black dust, which in some cases incrusts the quartz grains, and in others is distributed through the cementing quartz. Where it has incrusted the grains it has not by any means always prevented the optical continuity of the old and new material.

Flakes of white mica are rare, and a few zircons are present as usual.

(5) A dark red quartzite (30) from Sutton.

The grains of quartz are subangular, and the rock owes its colour to the pellicle of oxide of iron with which almost every grain is covered. This has prevented the cementing quartz from being deposited on the original, and it fills the interspaces which, from the angular character of the component grains and the consequent close fitting, are, on the whole, small, in masses which show a coloured mosaic in polarised light,

(6) A pebble from Sutton (24) which has the appearance of a coarse grit.

It shows, however, on microscopical examination, that it has been subjected to very great shearing. The larger pebbles are crushed, and in many cases recemented with new quartz; and in scarcely any one of them is the polarisation uniform and normal, but shows the irregular shadows due to the deforming of the crystal. Flowing as it were round them, and prolonged in considerable tails and streams, lie abundant minute flakes of a pale mineral, of high double refraction—probably some form of mica. A few large zircons are present, and there is a very large development of new quartz in the interlocking grains which characterise the schists, but on a small scale.

The rock is exactly the representative of some of the rocks from Sutherland, with which Dr. Lapworth made us familiar some years ago; but the fact of its being made out of a tolerably pure quartz grit produces, of course, a difference in its appearance from the absence of felspar and hornblende, which are present in the crushed gneisses of the north.

(7) A yellow quartzite (9) from Sutton.

This is an example of a rock that has been still further crushed and spread out than the last. The larger pieces forming the "eyes" are in many cases quite broken up, although the pieces are not moved away from each other or only slightly so, and the whole has been cemented into an exceedingly compact mass by abundant quartz, with mica flakes, in just the same way as in the last example.

(8) A dark-reddish, laminated pebble (22) from Alvechurch. Exactly similar stones occur at Sutton.

In this rock the crushing and rolling has gone still further than in the previous case. With the exception of a few opaque spots which seem to have determined the formation of many cracks, which have afterwards been filled or partially so with oxide of iron, I can distinguish no mineral but quartz. much of it in intricately interlocked grains. The whole rock has a good deal of dusty matter distributed through it, usually without any definite arrangement into lines. At most it is slightly heaped together in a few places.

A pebble (38) from Sidnal presents some peculiar features. It has the look of a laminated mass of somewhat opaque grains separated by pale yellow lines, which occasionally show themselves as flakes of golden mica. The crumbly nature of the rock makes a good section difficult to obtain, and what I have got is not in the best direction for examining the specimen. The grains are quartz, but a good deal crushed, and the cementing quartz has the interlocking texture A few fragments of felspar are suggested more than certainly recognisable.

The main points in which the quartzites which I have mentioned differ from those of the Lickey, of the Nuneaton-Hartshill ridge, and of the Wrekin, so far as they are known to me, are

(A) The original quartz grains are very much less perfectly rounded.

(B) The average size is much less.

(C) The quantity of zircons and other heavy minerals is much greater.

I may also refer to Mr. Teall's report on the subject in the paper of Mr. Harrison's previously quoted.

The next group of specimens derived from the pebbles to which I will call your attention is a remarkable set of tourmaline-bearing rocks.

They vary from pebbles consisting of pure white quartz, pierced by needles of tourmaline of the black variety, of quite considerable dimensions, such as No. 6, to others where the mixture of the minerals is more uniform, such as No. 48, from Sidnal Farm, Blackwell, and No. 25 from Sutton, and further to such a perfect schorl schist as No. 5, which I owe to the kindness of Mr. A.T. Evans, who collected it at the King's Heath pit. With these we find specimens at Alvechurch, Moseley, and Sutton, of a sort of breccia, Nos. 7 and 8, in which the component fragments are of a sort of schorl schist, and the cementing material contains also a very large quantity of the tourmaline.

In addition to these we find at King's Heath pebbles of a porphyritic granite and of an elvan in which a large amount of tourmaline is contained. In the latter rock it would appear from the forms of the tourmaline aggregates that they replace, in some instances at all events, crystals of felspar.

To take a few of these in more detail.

(9) Quartz-tourmaline rock from Sidnal's farm, Blackwell.

A coarse-grained mixture of the two minerals. The quartz is clear and polarises in large areas. There are a considerable number of fluid cavities, but none containing salt crystals were observed.

The tourmaline belongs largely to the variety which, in certain directions, possesses the splendid blue colour, in consequence of which the name indicolite has been given to it. As is usual, patches and blotches are differently coloured in the sections, and, except in basal sections, which in several cases are quite hexagonal, there is presented the striking dichroism peculiar to tourmaline. Clustered on the edges of the larger masses are fringes composed of fine blades of the same mineral, with the same blue and yellow colours. These fringes are at times of considerable length, *i.e.*, of about $\frac{1}{100}$ of an inch. It forms an object of great beauty for a low power.

(10) A dark rock (25) from Sutton.

This has the appearance of a dark quartzite, but a thin slice shows that it is really a very similar rock to the last, but of finer grain. It is, also, distinctly schistose, the tourmaline forming more or less connected ramifying strings, made up of very minute grains winding among grains of quartz.

There are, in addition, a number of small blades or needles of tourmaline of more usual appearance. The specimen has been much cracked, faulted, and recemented. The cracks have been filled up with quartz, which is traversed by needles of tourmaline, showing up very beautifully in the transparent quartz.

(11) Tourmaline schist (5) from King's Heath.

Beautifully crystallised schist, with a fine set of micro-faults. The quartz of the veins is larger grained than that of the body of the rock, and contains, as in the last case, needles of tourmaline radiating from the walls of the crack.

(12) Breccia from Alvechurch (8).

Exactly similar pebbles occur at King's Heath and Sutton.

It has the appearance of quartz rock which contained a few fine strings of tourmaline — it scarcely amounts to a tourmaline schist — broken up and cemented by a mass containing a much larger proportion of tourmaline, in many parts containing very little else. In hand specimens and in sections to the naked eye, the brecciated character is obvious, but from the fact of the original tourmaline and that of the cement being of just the same appearance, the whole has, under the microscope, the aspect of a quartz tourmaline rock in which the latter mineral has aggregated into clots and strings.

(13) Appears like a quartz felsite which has been subjected to strong alteration. The specimen (from King's Heath, No. 12) has a sparkling, obviously crystalline ground, in which large quartz grains are visible to the naked eye. There are numerous aggregated masses of crystals of black tourmaline, which in many cases have rectangular outlines indicating the replacement of felspar.

Under the microscope the tourmaline presents the usual characters, but is more widely disseminated through the section than appears macroscopically. The ground shows a mosaic polarisation in quite considerable sized grains, and there are no certain indications of any mineral but quartz composing it.

The larger porphyritic quartz grains are rounded, not very numerous in the section examined, and contain fine acicular crystals of a pale yellowish green, which do not show any definite faces from which to form a judgment as to their nature. There are also numerous fluid cavities, and in one or two of the grains the little crystals are arranged almost concentrically, the section being very nearly at right angles to the principal axis of the quartz. The quartz of the

ground also contains numerous fluid cavities, mostly minute, and some bands traverse the whole which have a dusty appearance, with a low power, but show themselves as due to minute flakes of irregular shape and brownish colour, when a power of about 400 is applied. These bands cut across the grains of the ground, and, indeed, are broader than the average size of them, so that they are probably cracks produced and filled up subsequently to the original metamorphism of the rock. A little apparently rectangular cavity was observed, lined with a number of little orange needles, which, on examination, proved to be quartz crystals stained with iron oxide, and frequently traversed by fine greenish-brown needles apparently of tourmaline.

I have compared with this specimen some sections of "Schorlaceous Elvan" from Cornwall, which Mr. Allport gave me some time ago. The similarity is very great, except that the process of alteration has gone further than in those in which the outline of the felspar portions were still visible (the structure was micro-granitic).

The porphyritic granite, of which mention was made (No. 14) only differs as a hand specimen from the last previously described in the occurrence of large porphyritic crystals of felspar, some being as much as 1in. long. In other respects, such as the grey ground, the porphyritic quartz grains, and the plentiful occurrence of tourmaline aggregates, there is no difference.

SHELLS FROM IRELAND.—Mr. G. W. Mellors, of Nottingham, who has recently visited our sister island, has sent me a small batch of shells which he collected there, and which may be placed on record, as Ireland is a country comparatively unknown to conchologists interested in the chorology of our land and fresh-water forms. From Roundstone, in Co. Galway: *Helix ericetorum* (Müll.) with its vars., *monozona* (Pasc.) and *alba* (Charp.), *Helix virgata* (Da. Costa) with vars. *albicans* (Gratel) and *lutescens* (Moq.), *Helix nemoralis* var. *libellula* (Risso) 00300, var. *carnea* (Roebuck and Taylor) 00300, and var. *Petiveria* (Moq.) 12345; from Westport. in Co. Mayo: *Helix rufescens* (Penn) and var. *alba* (Moq.), *Clausilia rugosa* (Drp.), *Pupa umbilicata* (Drp.), and *Helix rupestris* (Drp.).—J. W. WILLIAMS.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, July 2nd. Mr. W. B. Grove, M.A., in the chair. Mr. J. E. Bagnall, A.L.S., exhibited a number of

plants, collected in the Norfolk Broads by Messrs. R. W. Chase and C. Pumphrey, including *Cicuta vilosa*, *Sium latifolium*, and *Utricularia vulgaris*. The utricles of the last were shown under the microscope.—GENERAL MEETING, July 30th. Mr. W. P. Marshall, M.I.C.E., in the chair. Mr. T. E. Bolton exhibited specimens of *Utricularia intermedia*, from near Bournemouth, Dorsetshire; also, under the microscope, a living spider partly enclosed by one of the utricles of the plant. Mr. W. H. Wilkinson exhibited specimens of plants, from Kent. —GEOLOGICAL SECTION, August 20th. Mr. W. P. Marshall, M.I.C.E., in the chair. Exhibition of specimens by Mrs. Stewart:—*Epilobium angustifolium*, *Senecio squalidus*, from Acocks Green; also, hand specimens of Ben Nevis granite; Miss Taunton, Burdock (Wild Rhubarb), from Buxton; Mr. Herbert Stone, Goby, Sea Louse, and lichens, from Porth Gwarra, Land's End; Mr. Marshall, two nests of Trap-door Spider, from Bordighera in the Riviera.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 22nd. Mr. J. Collins gave a report of the excursion to Arley. The botany was highly successful, though the geology only gave meagre results. He laid upon the table a collection of the more interesting plants, *Saponaria officinalis*, &c. Mr. Deakin exhibited graptolites from the Llandovery Sandstone, Great Barr; Mr. Hawkes, a specimen of butterfly orchis, *Habenaria bifolia;* also, Australian seaweeds; Mr. Camm, *Arcyria dictyonema*, from Smethwick, a fungus new to Britain; Mr. J. W. Neville, lobes of proboscis of *Scatophaga merdaria*, calling attention to the special modifications fitting it for carnivorous habits.—July 29th. Mr. H. Hawkes read a paper on "The Botany of the Sea." The writer said that to those who lived inland a glimpse of the sea was always a source of pleasurable recollection, and gave a description of a visit to the south coast to devote a little time to that much neglected but beautiful order of plants—seaweeds. Although it was a common thing to see albums of marine algæ, yet in too many instances they were without names, and failed to impart other information. The various modes of reproduction were enumerated, and the germ- and sperm-cells, carpogonia and antheridia, which were generally found on different plants, described. Marine algæ were divided into three sections; about 370 species were found on our shores. The various seaweeds commonly found on the south coast were described, with the points of interest attaching to each. Attention was called to differences seen in these plants when growing under varying circumstances, influenced by various depths, light, shade, saltness of the water. &c. The paper also dealt with their economic value, habitats, and areas of distribution. The paper was illustrated by herbarium specimens, microscopic slides, diagrams, and a series mounted for the lantern.—August 12th. Mr. J. W. Neville exhibited specimens of *Monograptus Sedgwickii*, from metalliferous slates of Llandovery age, Central Wales; Mr. Linton, a collection of land shells, from Scarborough; Mr. Corbet, fossil corals from the Carboniferous limestone, Shropshire; Mr. H. Hawkes, algæ, from Weymouth, including some specimens not commonly found there, but brought up by the recent rough weather; Mr. Camm, a fungus new to Britain, provisionally named *Alwisia intermedia* (Mass. and Camm). Under the microscope, Mr. J. Collins exhibited *Hydrodictyon utriculare*, from Sutton Park; also, *Chætophora elegans;* Mr. Hawkes, *Ceramium ciliatum* and *Dudresnia coccinea*.

THE FLIGHT OF BIRDS AND INSECTS.*

BY EDMUND CATCHPOOL, B.SC.

The question, "How do animals fly?"—a difficult one to answer in any case—has been made much more difficult by two facts connected with it. One of these is that the study of flight lies on the border-land between the sciences of biology and physics, while those who have devoted themselves to it have usually been specialists in one only of these sciences. The other is the fact that there are two methods of flight, as distinct from each other as walking and jumping, and that from want of distinctive names these are often confused together. As an instance, one among many, of the first of these causes, let us take the common idea that birds are at least partly supported in the air by the possession, in the bones and other parts, of cavities filled with warm air. It is, of course, certain that this warm air, acting like that in a hot-air balloon, does to some extent support the bird; and equally certain that this support never amounts to as much as the weight of a single quill feather on the bird. This result of a simple calculation from physical data disposes at once of the air-sacs as a practically important element in flight.

I will give another instance, which will help to clear the way to an understanding of the flight of birds. It is quite commonly believed that the feathers of the wings of birds open to let the air pass between them during the upstroke, and I have had it shown to me, by directing a jet of oxygen on the upper side of a wing, that when the pressure on this side exceeds that on the lower side, the feathers do open in this manner. This is quite true, but in flight the pressure never is greater on the upper surface, as a simple physical calculation proves. If the pressure on the upper surface was greater than on the lower, the bird would, of course, be unsupported during the upstroke, and would fall with the same velocity as any other unsupported body. In an upstroke, lasting $\frac{1}{8}$ sec., like that of the buzzard, the body would fall at least 8in., and, as observation shows that it does not, the pressure must always be greater on the lower surface.

I have begun with these two illustrations because in this paper I shall treat the subject of flight purely as a physicist. I do not pretend to be anything else, and I wish to show that

* Read before the Birmingham Natural History and Microscopical Society, January 8th, 1889.

there are some, at any rate, of the disputed points in the study of flight which can be solved by purely physical methods.

The fundamental fact in all flight, from a physical point of view, is the tendency of every flat surface moving in air to move in the direction of its own plane. This arises from the fact that any motion towards either side at once produces a compression of the air on that side, and so a resultant pressure nearly at right angles to the surface and in the direction opposed to the motion. The fact may be loosely but shortly expressed, by saying that every flat surface forced to move in air tries to move edgewise. Our experience of fans, cards, thin books, and the like, makes this tendency quite familiar. One way in which it may be used to support a body in the air is illustrated by a child's toy, once so popular as to earn the honour of the notice of "*Punch.*" In this toy four plane surfaces of paper stretched on wire are fastened like the sails of a windmill to a centre, and the whole can be spun like a top with a piece of string. The four wings or sails are so set that, when spun, the higher edge of each is in front, so that each wing, tending to move edgewise, is urged upward, and the toy rises in the air until its velocity is spent. Or similar wings attached to one pan of a pair of scales, and made to rotate by a twisted elastic cord, will raise the pan to which they are attached. To make such a model fly by itself in the air something more is necessary, for if left free the other end of the elastic cord will untwist and the wings remain still; but as in the toy Japanese butterflies, the other end of the elastic cord is fastened to large stretched surfaces of paper arranged at right angles to the direction in which the elastic cord would turn them, so that there is a great resistance to its uncoiling at that end, or if, as in the original arrangement of Sir G. Cayley, that end is attached to another set of wings inclined in the opposite direction, so that these rotating the other way, may also tend to rise, we have an arrangement which will fly by itself, and differs in principle from a small insect in only one important respect.

An insect might, no doubt, be created which should fly exactly in this way; it is, indeed, mechanically a far better arrangement than that of actual insect's wings. But such an insect would have to be created; it could not grow. No part of any animal can rotate always in the same direction; the blood-vessels and nerves, which are necessary for its growth, would be twisted off. So, for locomotion on land, we have the alternate motion of legs, not the continuous rotation of a wheel; for the water, the oscillations of a tail, not the revolutions of a screw; for the air, vibrating wings, not the

revolving vanes of our model. These backward and forward motions are not the best, but they are for the animal the best possible.

In the actual insect, then, the wings must move backwards and forwards, not round and round, but the motion is still horizontal, not vertical like that of a bird's wings; the white blur seen when a fly balances itself in the air clearly shows this fact. As the wing surfaces must always be so inclined that the upper edge is in front, this inclination must change with the direction of the motion. In the insect this is managed automatically by the simple device of placing the surfaces vertical, and making the upper edge stiff, the lower thin and flexible; the resistance of the air to their motion then sets them in the required position, since it forces the flexible lower edge further back than the stiff upper one.

If we make a pair of wings by stretching thin paper over two thin strips of cane tapered to a point, and bent nearly at right angles near one end, these wings will resemble those of the insect in being stiff all along one edge and flexible along the other; and if we attach these to a frame, so that the cane edges are uppermost and horizontal, while the planes of the paper are vertical, they will be in a position like the insect's when it flies. If, by means of twisted elastic cord driving a crank and connecting-rod, we cause the strips of cane to move horizontally backwards and forwards like the oars of a boat, it will be seen that at each stroke the surface of the wing changes from a vertical to an inclined position. If this model is placed on one pan of a balance, and partly balanced by weight in the other pan, the pan containing it will rise as soon as the wings begin to move, showing, as might be expected, that these inclined surfaces tend to rise.

It will be seen that the principle of this model, and of the insect which it imitates, is really the same as that of the models with rotating wings, and that the adoption in the insect of an oscillatory instead of a rotary motion is a necessity not for flight but for growth; but it must not be supposed that it is as good an arrangement considered mechanically. All oscillatory motions are wasteful, and this waste becomes an important quantity whenever, from the nature or lightness of the structure, there is a considerable want of rigidity. In the insect the oscillatory movement is the cause of great waste of power. At the beginning and at the end of each stroke the wing is moving too slowly to bend the surface into the slanting position required; these parts of the stroke, therefore, exert no supporting power at all, and there are further losses from the want of sufficient rigidity in the nervures, which shortens the stroke without any corresponding diminution of work. So that while a set of sloping

wings, moving horizontally like those of an insect, but rotating always in the same direction (Sir G. Cayley's model, in fact), forms, probably, the most economical flying arrangement, for a given wing surface, which is mechanically possible. the reciprocating motion of the insect's wings, though on the same principle. is the most wasteful of all methods of flight in use, the energy required to support a given weight being, as appears from some not-too-satisfactory experiments of mine, between three and four times the amount that would be necessary if the same wings could rotate always in the same direction. A method so wasteful must be confined to the smaller flying animals, whose wings, enormously large in proportion to their weight, are a source of economy which balances this waste.

There is another reason why this method of supporting a weight in the air must be confined to small animals. Though this model with oscillating wings supports part of its weight when in motion, as shown by the rise of the scale-pan, it cannot be made to rise by itself, for even if made light enough, which would be difficult, the strokes are so slow that during each stroke the framework, which, of course, is acted on by a force equal and opposite to that which drives the wings, would acquire considerable velocity; in fact, the framework would move and not the wings. That in the insect the opposite is the case results from the extremely rapid reversals of the motion of the wings, and this sets a limit to the size of the animals which use this method of flight. For since (as may be shown mathematically) the velocity of the tips of the wings cannot be increased without great waste of energy, and the strokes cannot be shortened without a similar waste arising from the springing back of the wing at the end of of each stroke, it follows that the larger the wings the slower must be their vibrations, and hence the greater must be the oscillations of the body of the animal compared with those of the wings. Hence, this method of flight must be confined to creatures of small size.

The pressure of the air acts, of course, directly on the wings, which in their turn support the body, and the upward pressure on each wing increases with its increasing velocity from the beginning to the end of each stroke. So that, not being perfectly rigid, each wing rises a little during the stroke, and springs down again when it stops at the end, thus describing a kind of horizontal figure of eight (∞). This has been illustrated by Dr. Pettigrew, in his "Animal Mechanism," but it does not seem to have the importance he supposes—in fact, any wing not perfectly rigid must move in this way; that of the model described above does so, as may

be shown in a darkened room, by attaching a small piece of glowing charcoal to it. A small piece of gold leaf fixed with gum to the top of a fly's wing describes a similar curve. In order that an insect may advance through the air, the position of the wing surface, when not bent aside by the air, must be altered from a vertical plane to one sloping upward and forward. This might be accomplished by the whole insect assuming a more horizontal position, or by a change in the position of the wing itself, which might or might not be accompanied by a change in its motion. The observation of the change is very difficult, as the insect moves forward instantly when it takes place, but I incline to the view that the only alteration is a rotation of the wing round its stiff edge, so that it slants downwards and backwards from this edge instead of hanging merely downwards. In any case, it takes this position, and two distinct and independent results immediately follow. First, the pressure against the air being now directed downwards and backwards instead of merely downwards, the insect is urged forwards as well as supported by the motion of the wings. This would be the case just as much even if the insect's body was fastened so that it could not really move forwards. But besides this, the wing surfaces having on the average this upward and forward slant, the forward motion of the whole insect through the air causes them to tend to rise quite independently of their vibrating motion, so that there is a second supporting force which would still exist even if the insect ceased to move its wings, if only they were outstretched and the forward motion of the whole insect continued. I must be excused if I insist rather wearisomely on this point; it is a very important one, for it is by the development of this second and supplementary means of support that a method of flight is arrived at which is available for larger animals, and we have the possibility of the bird.

(To be continued.)

THE FUNGI OF WARWICKSHIRE.

BY W. B. GROVE, M.A., AND J. E. BAGNALL, A.L.S.

Sub genus XXVII.—Crepidotus.

(Continued from page 193.)

247. **Ag. mollis,** *Schæff.* On logs. Aug.-Dec. On the foot of a bridge, in the black lands (Ipsley), *Purt.*, ii., 659. Hopsford, near Brinklow, *Adams.* Warwick, *Perceval.* Solihull, *Hawkes!* Sutton and Sutton Park; Packington Park.

248. **Ag. haustellaris,** *Fr.* *Ag. resupinatus*, With. On rotten wood, Packington Park, *With.*, 298. "Not observed since the time of Withering," *Berk. Outlines*, p. 164. Since recorded from Penzance (*Ralfs*), 1883.

249. **Ag. Rubi,** *Berk.* On rotten wood. Oct. Dunn's Pit Lane, Kenilworth, *Russell, Illustr.*

250. **Ag. pezizoides,** *Nees.* *Ag. campanulæformis*, Purt. On dead branches of trees. Rare. Feb. Near Pophills, *Mrs. Rufford*, *Purt.*, iii., 289. "Found only in Warwickshire," *Berk. Outlines*, p. 165.

Sub-genus XXIX.—Psalliota.

251.—**Ag. arvensis,** *Schæff.* In meadows. Aug.-Oct. *Ag. campestris*, var. 4. "Edgbaston Park, under large lime trees," *With.*, 226. Kenilworth, *Russell, List.* Fields, Ansty, *Adams.* School Close, *Rugby School Rep.* Sutton Park; Packington; Shustoke; Castle Bromwich, etc. This species has also occurred in cellars within the city of Birmingham on several occasions. "In the district east of Birmingham, where it is known as the 'Champignon,' it is freely eaten by certain country people; and I know a small village in the West Riding of Yorkshire of which the same is true, as doubtless of many others."—W. B. G.

252. **Ag. campestris,** *Linn.* Rich pastures. Frequent. Aug.-Oct. Warwick, *Perceval.* Fields about Ansty, *Adams.* Meadows, The Spring, Kenilworth, *Russell. Illustr.* Knowle, *Hawkes.* Packwood; Allesley; Sutton Park; Middleton; Coleshill; Sheldon. etc.

Var. *silvicola*, Vitt. Growing at the base of cottage, Field Gate Lane. Oct., 1874, *Russell, Illustr.*

Var. with *scaly pileus.* Rookery, Edgbaston, *With.*, 226. A form in which the pileus is covered with flattened pencils of brown hair, identical with that recorded by Withering, still occurs in Edgbaston Park.

The form *alba*, with beautiful silky white pileus, is common in Packington Park, and at Bradnock's Marsh. The var. *Ag. villaticus*, Brond., which is more likely to be a distinct species, was represented by grand specimens in a spinney at Hampton. on the edge of a meadow. These exactly agreed with Cooke, Illustr., pl. 585; the pileus measured over 12ins. in diameter, and the stem 2½ins. in thickness.

253. **Ag. silvaticus,** *Schæff.* Kenilworth? *Russell, List.* ["I found this at the Leasowes, Halesowen, Worcestershire, in July, 1885."—W. B. G.]

Sub-genus XXX.—Stropharia.

254. **Ag. versicolor,** *With.* "This is a rare species. I found it only once, and then near the bridge in Edgbaston Park which goes over the stream that feeds the large pool," *With.*, 163. Not found since the time of Withering, either in Britain or, we believe, abroad.

255. **Ag æruginosus,** *Curt.* Meadows, etc. Common. Sep.-Nov. Rookery, Edgbaston! *With.*, 255. At the foot of the rails between Alcester and Oversley Bridge, *Purt.*, ii., 643. Crackley Wood! *Russell, Illustr.* Combe, *Rugby School Rep.* Solihull. *Hawkes!* Witton; Sutton; Middleton; Olton; Solihull; Coleshill Pool; Maxtoke; Packington Park; Marston Green, etc.

256. **Ag. albo-cyaneus,** *Desm.* Meadows and woods. Oct. Crackley Wood and Red Lane, Kenilworth, *Russell. Illustr.* Hopsford, *Adams.* Bilton, *Rugby School Rep.*

257. **Ag. melaspermus,** *Bull.* Rare. Sept.-Oct. Heathcote Farm, Warwickshire, *Perceval.* Kenilworth, *Russell, Illustr.* The true *Ag. coronillus,* Bull = *Ag. melaspermus,* Fr., occurs in Sutton Park and at Coleshill Pool.

258. **Ag. squamosus,** *Fr.* Woods. Sept.-Oct. Rather rare. Kenilworth, *Russell, Illustr.* Sutton; Trickley Coppice, abundant. *Ag. thraustus,* Kalch., var. *aurantiacus,* Cooke, Illustr., pl. 555; Sutton and Packington Park.

259. **Ag. luteo-nitens,** *Fr.* On sawdust, etc. Rare. Crackley Wood, Kenilworth! *Cooke,* Grev. xiv., 37; Illustr., pl. 604.

260. **Ag. stercorarius.** *Fr.* On dung. Oct. On dung, pine wood, Coleshill Heath, Oct., 1884; Edgbaston Park.

261. **Ag. semiglobatus,** *Batsch.* On dung. Very common. Sept.-Nov. Crackley Lane, Kenilworth, *Russell, Illustr.* Common in fields, Ansty, *Adams.* Sutton Park: Middleton; Kingsbury; Marston Green; Coleshill Pool; Edgbaston; Olton, etc. "I have found, in Sutton Park, an *albino* form, with the gills white owing to the non-development of the spores."—W. B. G.

Sub-genus XXXI.—Hypholoma.

262. **Ag. sublateritius,** *Fr.* *Ag. fascicularis,* var. 2, *Purt.* Vars. 3 and 4, *With.* On old stumps. Frequent. Oct. Edgbaston, *With.*, 264. Ragley Wood, *Rufford, Purt.*, iii., 225. Warwick, *Perceval.* Crackley Wood! and Kenilworth, *Russell, Illustr.* Ansty, *Adams.* Sutton Park; New Park; Coleshill Pool; Kingsbury Wood near Three Pots, Watling Street; Umberslade, etc.

263. **Ag. epixanthus,** *Fr.* On stumps. Oct. Hopsford, near Brinklow, *Adams.* Sutton?

264. **Ag. fascicularis,** *Huds.* Old stumps. Very common. Oct. Edgbaston. *With.*, 268. Warwick, *Perceval.* Crackley Wood! *Russell, Illustr.* Ansty, *Adams.* Sutton Park; Coleshill Pool; Middleton; Kingsbury Wood, etc.
265. **Ag lacrymabundus,** *Fr.* Stumps, and on the ground. Oct. Footposts, Station Road, Kenilworth, *Russell, Illustr.* On banks, near Cut Throat Wood, Solihull; Alveston Pastures; near Stratford-on-Avon.
266. **Ag. velutinus,** *Pers.* On stumps. Aug.-Oct. Dale House Lane and Crackley Lane, Kenilworth, *Russell, Illustr.* Fields, Ansty, *Adams.* Trickley Coppice; New Park; Marston Green; Olton; Packington Park; Langley.
267. **Ag. Candolleanus,** *Fr.* On stumps. Sept.-Oct. Shilton, near Coventry, *Adams.* Knowle, *Hawkes!* Trickley Coppice; Shawberry Wood, Shustoke; Solihull; Alveston Pastures; Langley.
268. **Ag. appendiculatus,** *Bull.* Stumps, etc. Oct. Cherry Orchard, Edgbaston, *With.*, 282. Oversley; Wixford, *Purt.*, iii., 280. Red Lane, Kenilworth, *Russell, Illustr.* The Fields, Combe, *Adams.* Aston Park; Sutton Park; New Park, Middleton; Bretnal Wood, near Atherstone; Packington Park; Penns; Shustoke, etc.
269. **Ag. egenulus,** *B. and Br.* Amongst grass. Oct. Spinney, near Newbold-on-Avon, *Adams.*
270. **Ag. hydrophilus,** *Bull. Ag. piluliformis,* Purt. In woods. Sept.-Oct. Ragley Wood, *Purt.*, iii., 234. Hopsford, near Brinklow, *Adams.* New Park. Middleton; Sutton Park; Trickley Coppice; Corley; Shirley." "I agree with those who consider *Ag. piluliformis* to be the young state of this species."—W. B. G.

(*To be continued.*

THE FIN WHALE FISHERY IN NORTH LAPLAND.*

BY H. BALFOUR, M.A., F.Z.S.

(*Concluded from page 202.*)

First of all let me say that the methods adopted in the Finmarken fishery differ markedly from those of the Greenland and South Sea whalers. The Greenland Whale is searched for in large wooden sailing vessels, mostly barques of 400 to 500 tons gross, built for heavy ice work, with auxiliary steam power. When a whale is sighted close at hand, boats are launched, and the whale is harpooned from

these; formerly always with a harpoon thrown by hand, but now usually small swivel harpoon guns are used in addition, the guns being some 75lb. in weight.* The harpoons are necessarily somewhat small and light, and the whale-line measures only 2¾ inches in circumference. Poison has been tried in the South Sea fisheries with some success, as also small explosive bombs; but nothing of the nature of the formidable weapons used by the Finmarken whalers has been used elsewhere. It is only comparatively recently, in fact, that the Northern Rorquals have been regularly sought after at all, and this for various reasons.† Firstly they are far less valuable individually than the Greenland or Sperm Whales, and secondly they are extremely active and powerful, frequently of enormous size, far exceeding the dimensions of the Greenland Whale. They are, therefore, very dangerous to approach in small boats, which would stand but a poor chance if pitted against these vigorous animals. These were, however, some years back, extremely abundant along the north coast of Finmarken, and were seen in numbers close in shore, and even far up the larger fjords. Especially conspicuous was the huge Blue Whale (*B. Sibbaldii*), the most valuable of the Rorquals, which used to infest the Varanger fjord in large numbers.

It is now about twenty-three years since the enterprising Norwegian sailor, Svend Foyn, commenced a systematic pursuit of these animals. He obtained a monopoly of this fishery for some years, and conducted it on an entirely new plan. In 1882 other companies were able to engage in this then lucrative pursuit, and since then many companies have entered upon the business, and the whales are becoming scarcer and far more shy every year, having to be sought for much further afield than formerly. Svend Foyn's first factory was established at Vadsö, at the entrance of the Varanger Fjord, so much frequented by the Blue Whale, which at first was alone the object of pursuit. Since then this factory has been closed, and Foyn has moved his business westwards, as the fishery has become somewhat played out in these regions. The business is becoming very precarious, and companies frequently break up in consequence of poor seasons, or move their establishments elsewhere.

* Harpoon guns were first used in Greenland whale fishery about the year 1730.

† Scoresby, as long ago as 1818, made several attempts to capture the Blue Whale (*B. Sibbaldii*), but he met with no success, as his lines were invariably broken.

The vessels employed in the chase are small iron steamers of about eighty tons, with horse-power varying up to thirty-five or more. They are mostly about 80ft. long, though there is considerable variety in the dimensions, &c. They are good sea boats, and will stand a heavy sea, though they are washed over and over in even a moderate swell. The engine room is placed amidships, and there are two small masts. The foremost carries the "crow's nest," from which the harpooner keeps his look-out; it also carries the "accumulator" or relieving tackle, of which more anon. Each whaler is furnished with two to three small boats. In the extreme bows is situated a small cannon for firing the harpoon. This cannon is short and very thick, being often as much as 4½ inches thick at the muzzle; its weight is usually about 15cwt., and it works upon a pivot, which allows of a horizontal rotary motion, and upon trunnions, which give a vertical play. There is a kind of pistol-stock handle held by the harpooner, who can thus aim in any direction with considerable rapidity, there being only a few pounds resistance to overcome. The charge is about ½lb. of powder, and the gun is fired usually by pulling a string, the recoil being minimised by means of indiarubber cushions behind the trunnions. Jutting out ahead of the gun, over the stem of the vessel, is a small platform, on which the harpooner can stand if necessary, and upon which part of the line is coiled, so as to run out easily when the gun is fired. The range is short (roughly speaking, about 12-13 yards).

Much interest, of course, centres round the harpoon, which is truly a most deadly weapon. I was fortunate in having presented to me one of the earliest patterns of this weapon, dating back to the commencement of Svend Foyn's experiments in improving the gun-harpoon. It is interesting to compare this with the modern form, which is a far more formidable weapon. This old harpoon is made entirely of iron, and is divided into three principal parts: (*a*) The head, which is comparatively large, and of pyramidal shape, with slightly concave sides. This is hollow inside, so as to contain a charge of gunpowder; the point is perforated and communicates with the chamber by means of a duct, which contains the fuse by which the charge was exploded when the head was buried in the whale's body. The head is screwed on to a worm at the end of (*b*) the lower part of the stock. This is rounded and thick, and carries two pairs of good-sized barbs, which work upon pivots at their bases, so as to lie close to the stock, and only open out when resistance is offered to a backward strain. This portion is also

perforated for the attachment of the line. Behind this is (*c*) the upper part of the stock, which is made in the form of four flanges at right angles to one another, or + shaped in cross section. This shape lightens this end of the harpoon, and has the same effect as the feather of an arrow, On to the end of this is fitted loosely an iron disc, three inches across, and fitting the bore of the gun. This takes the force of the explosion, and was, of course, lost when the harpoon was discharged. The weight of this harpoon is 12lb. It is quite obsolete, having long ago been superseded by improved patterns. My specimen actually belonged to a Dane, named Brandt, but may be taken as a type of Svend Foyn's early pattern of harpoon,

Foyn carefully studied the various designs of harpoons from different parts of the world, and spent large sums of money in constantly improving upon his own designs.

The modern harpoon, as in use to-day, is a great improvement upon the old model. The whole weapon, when ready for use, is about 6ft. long, and costs about £5 10s., and the stock alone weighs about 128lb. Beginning, as before, at the "business" end, there is first the sharp point, which has either two or three edges, and is three or four inches long. This acts as a "pilot" for the rest of the weapon, and is screwed into a large conical shell, 9in. long, and containing ¾lb. of gunpowder. This shell is screwed on to the end of the stock, which is perforated longitudinally by a small duct, in which lies a glass tube containing a fulminating powder, which communicates with the charge in the shell. Above this are two pairs of enormous barbs or flukes, pivoted at their bases. The lower pair are so arranged that when they open their bases meet inside and crush the glass tube, exploding the fulminating charge, and so also the charge in the shell, which is blown to pieces in the whale's body. Between the lower and upper parts of the stock is a large shackle, which shakes loose when a strong strain is applied, and prevents the stock breaking. The upper part of the stock is in the form of two stout bars, joined at the ends, and enclosing a space along which the grummet, to which is attached the line, can slide. This grummet is very strongly made of iron wire, of about fifty strands, strongly served round; to it the end of the line is spliced, The line is enormously strong, about seven inches in circumference, and is made in Norway of the finest Russian hemp. It is carefully tested to an enormous strain before being sent out. Each line is usually 120 fathoms, but several may be joined together. They are kept coiled up in huge bunkers in the forehold of the vessel.

The last important item which I have to mention is the "accumulator" or "relieving tackle." This apparatus is intended to minimise the bad effect of sudden jerks or strains upon the line. It is suspended from the foremast, and consists essentially of two cross-pieces, connected together with a number (12 or 15) of very strong indiarubber bands, which pass round them. The upper cross-piece is attached to the mast, and to the lower is fixed a wheel or metal block, over which is passed the harpoon line. A sudden jerk upon the line, caused by the whale starting off at suddenly increased pace, is reduced to a gradual strain by the stretching of the indiarubber bands, and a possible source of danger, or the breaking of the line, is thus to a great extent avoided.

When cruising about in search of whales the harpooner is stationed aloft in the "crow's nest," which is a very large tub placed high up on the foremast. From this post of vantage he has an extended view, and, when a whale is sighted, he gives the signal, and the vessel starts off in pursuit. The harpooner descends and takes up his station at the gun, with the pistol-stock handle in one hand and the firing cord in the other. When the whale is within range, about 12 or 13 yards, the gun is quickly brought to bear, and, usually as the whale rises across the line of sight, the string is pulled and the harpoon discharged. If the harpoon is "fast," the line runs out rapidly, and the steamer is soon being towed along; the engines are then reversed to full speed astern, so as to drag as much as possible, but in spite of this the vessel may still be towed along at a pace of eight or nine knots ahead. When a sufficient strain is applied to the line, the "flukes" of the harpoon break away from the lashings which secure them, and, as they open, crush the fulminating tube, and explode the shell inside the whale's body. Even then it is not necessarily "all up" with the beast, as it may still continue running for some time, often some hours, before finally succumbing. Mr. Cocks ("Zoologist," 1887) gives an interesting account of one whale which continued running for *six hours* from the time of its first being harpooned, in the course of which it towed two steamers along, with a harpoon from each in its body, both shells having properly exploded. This is certainly an exceptional example of endurance, but is a good instance of the enormous strength and great vitality of these animals. When the strength of the whale is spent, the steamer comes alongside, the boats are launched, and the men proceed to finish the work with lances, the shafts of which are enormously long. The beast usually gives a last convulsive struggle, known as

the "flurry," "screaming" loudly if it is a Humpback, and then it is all over. The next thing is to prepare the whale for being towed ashore to the factory, and for this the flukes are cut off, as they would impede progress. A chain or rope is then fixed just in front of the tail, and the whale is then towed tail first. At first the carcase shows but little above the water, but very soon it begins to swell up with gas, and floats higher and higher out of the water, till after the lapse of a few hours it is quite balloon-like and by no means "very like a whale." It may even burst with the pressure, and, if pierced in this condition, a loud report is often caused by the liberation of the confined gas.

The whale is thus towed to the company's factory, and it may be well here to give a brief description of this establishment. There is a large main building divided into two floors; the ground floor is given up to the huge boilers and tanks, where the oil is extracted by boiling and steaming from the blubber, &c. Into the upper storey is received the blubber as it is cut off, and leading up to this floor is a long slide, up which the pieces of blubber are drawn by means of a chain and windlass. In front of the factory is built a small pier, jutting out some little way into the sea at high tide; at the end of this is a crane, and on it are windlasses for hauling up the heavy bones, &c. The whale is hauled as high as possible up the shelving beach at high tide, usually head first; and, as soon as the carcase is sufficiently exposed by the falling tide, the operation of cutting up, or "flensing," commences. The men are armed with large knives, fitted with wooden handles about four feet long. A longitudinal incision is made at some part of the body, extending perhaps twenty feet, and another is made parallel to the first some two or three feet away from it; by means of transverse cuts a long piece of blubber is marked off, and a chain is then brought from a windlass at the base of the wooden slide leading to the upper storey. This chain is fixed to that end of the piece of blubber marked off, which is farthest from the the factory, and a certain amount of strain is applied by means of the windlass. The "flenser" then cuts away the connective tissue underlying the blubber, and the huge "blanket" piece is thus partly pulled and partly cut away, and hauled up to the base of the slide. Here the chain from the upper storey is fixed on, and the piece is dragged up the slide into the upper room, where it is divided up into smaller pieces for boiling down. The rest of the blubber is similarly removed, and the tongue is cut out and sent up the slide. The carcase is turned over at high tide, and the other side is

operated upon. The lower jaw bones are cut out, and the baleen plates removed to be divided up into the separate laminæ, and dried in the open. When all the blubber and other oil-bearing portions have been removed, the carcase or "crang" is towed off and sold to a guano factory, where it is converted into manure.

The oil procured is of different qualities, according to the part from which it has been obtained, that from the back of the Common Rorqual being reckoned the best; next in order comes that from the blubber of the belly and the tongue, and so on (see account in Mr. Cocks' paper).

In 1885 Norwegian "Finner" oil sold for £18 a ton; and in the same year Greenland whale oil sold for £22 a ton (formerly as much as £40), and Bottlenosed Whale oil £25 a ton (formerly £60). It is used for a variety of purposes; for burning, lubricating machinery, currying chamois leather, in batching flax, and in the manufacture of jute fibre, &c.

The whalebone, or baleen (called commercially "whale-fin"), procured from the Rorquals is very inferior to that of the Right Whales. That of the Blue Whale is more valuable than that of the other Balænopteridæ; the price last year being £180 a ton, and this was considered a fairly good price. Greenland Whale baleen will fetch £1,500 a ton or more, but the market prices vary enormously every year.

The otherwise rejected carcases with the bones are, as I have said, sold to the various guano factories, where they are converted into guano and glue. For guano the "crang" and bones are dried, ground, and mixed; some comes to England, but the greater part is sent to Hamburg, where the guano is subjected to chemical processes.

The bones are for the most part useless for manufacturing bone articles, as they are so porous, but from the outer portions of the lower jaw can be made various small articles, knitting needles, &c.

Another useful product of this industry is "whale-beef." Although this no longer ranks as a delicacy, still in former times it was considered as such. In the 12th to the 15th centuries, whale flesh was largely consumed by the Dutch, French, and Spaniards, and was sold in the markets of Bayonne and Biarritz, the tongue being especially favoured. Henry III. was particularly fond of it, and it appeared as a luxury at the municipal banquets. Whale flesh is not altogether scorned now-a-days. The "Xiania Preserving Company" tin large quantities of the flesh of the Rudolphi Rorqual, that of other species not being considered good. The Lapps frequently come down to

the factories, and are allowed to cut away huge pieces of the meat while the whale is being cut up; this they deposit in large tubs and add salt to it, to preserve it for winter consumption. They are not allowed to take the *fat* of the whales, but, nevertheless, if the foreman turns his back for a moment, they immediately pounce on the nearest lump of oily fat and carry it off in triumph.

Various dangers are incurred by the Norwegian whalers; explosions of gunpowder on board sometimes occur and cause serious damage; sometimes, too, the shell of the harpoon does not burst till the boats are alongside of the whale for lancing. In this way boats occasionally have been smashed in, and the crews placed in great danger. Whales occasionally do considerable damage, even to the steamers, by charging viciously, and, when we consider their enormous power and great activity, we can easily see that this is a serious form of danger. Besides these, various other risks are incurred which I need not mention.

In the course of a single paper I cannot expect to give more than the merest sketch of the whale fishery of these regions. The subject is one full of interest to the naturalist, as a vast amount with regard to the habits of the whales still remains to be discovered, and a few only of the Northern species of whales have been properly figured. Mr. Cock's papers in "The Zoologist" have done much towards drawing attention to this subject, and he has entered into detail upon many points to which I have been able to refer only in the briefest manner. His account of last year is not as yet published, but we may look forward to it with interest. Other attractions drew us away from the coast, after somewhat short visits to a few of the whaling stations. A journey into the interior of Lapland, up the Pasvig River to Lake Enare, had irresistible attractions; and, by the time we had returned to the coast, the whaling was over for the year. The factories were closed and deserted by the men, though one factory, which I visited again in Vardö on my return journey, presented nevertheless a very animated scene, as thousands upon thousands of seagulls, skuas, duck, and other sea birds were congregated there, on the beach and in the water, apparently busy enough over clearing away the rejected remnants of the season's spoils.

I append here for those interested in the subject a list of a few of the more interesting English papers dealing with the Northern Balænopteridæ:—

A. H. Cocks: Papers on the "Finmarken Whale Fishery," *Zoologist*, 1884, pp. 366, 417, 455; 1885, p. 134; 1886, p. 121; 1887, p. 207; 1888, p. 201.

W. H. Flower: "Notes on Four Specimens of the Common Fin Whale," *Proc. Zool. Soc.*, 1869, p. 604 and plate.

Robert Heddle: "On a Whale of the Genus Physalus," *Proc. Zool. Soc.*, 1856, p. 187. (Plates of Common Rorqual.)

R. Collet: "On the External Characters of Rudolphi's Rorqual," *Proc. Zool. Soc.*, 1886, p. 243; (two plates of this species; also engravings of *Balænophilus*, *Echinorhynchus*, and *Calanus*).

Robert Brown: "Notes on the History and Geographical Relations of Cetacea frequenting Davis Strait and Baffin's Bay," *Proc. Zool. Soc.*, 1868, p. 533.

Robert Gray: "Notes on a Voyage to the Greenland Seas," *Zoologist*, 1887, pp. 49, 94, 121 (plate of *B. mysticetus*); 1889. pp. 1, 41, 95.

E. Harting: "Distinguishing Characters of British Cetacea," *Zoologist*, 1878, p. 1.

Eschricht, Reinhart, and *Lilljeborg:* "Recent Memoirs on the Cetacea," *Ray Soc.*, 1866.

THE PETROLOGY OF OUR LOCAL PEBBLES.

BY T. H. WALLER, B.A., B.SC.

(Concluded from page 219.)

On examining a thin slice, however, a well-marked micro-granitic structure becomes visible. not of a very minute character, the individual portions of quartz and felspar being some ·001 to ·002 of an inch in diameter. The porphyritic crystals of felspar are all orthoclase. They are very cloudy, and in one or two places are invaded by the tourmaline, as if we saw the beginning of the process what has ended in the last-named pebble in the formation of a tourmaline aggregate replacing the entire felspar crystal. The tourmaline crystals are distributed along lines in the felspar substance, apparently the traces of what Prof. Judd terms solution planes, along which the alteration of crystals frequently takes place. Where the change is complete the banded arrangement is still visible, in such a way as if along these planes radiating masses of the tourmaline had penetrated into the felspar until the whole was a mass of interlacing crystals.

The tourmaline is not in most cases in the large crystalline masses previously mentioned, but much more minutely and confusedly crystallised. In one case long arms of crystals radiate from a centre, the axes of the crystals being parallel to the length of the arms.

The porphyritic quartz is crowded with relatively large cavities, frequently arranged in lines, which appear to be

continuous through two neighbouring grains without any trace of them being visible in the crystals of the ground mass. The arrangement of the quartz and felspar in this ground mass shows in places an approximation to pegmatite arrangement, and in some cases the boundaries of the quartz seem indented, as it were, by the quartz of the ground, as if the crystallisation of the latter had been regulated by the previously existing quartz.

The felsites which occur among our pebbles are of two or three principal types. There are reddish-brown quartz felsites, grey rhyolitic specimens, and others of the grey, and esitic type, which are so more plentiful in Wales.

(14) At Sutton, King's Heath, and also at Catspool, near Alvechurch, there occur pebbles of red quartz felsite, with, in most cases, abundant porphyritic quartz and felspar crystals. Many of the latter are still fairly fresh, and show bright cleavage faces on a fractured surface.

The micro-structure is very similar in all cases, the ground mass being a micro-granite of rather fine grain. The quartz has the deep bays and tongues of the ground mass running into the grains which are so common in the felsites. The felspar is partly at any rate triclinic, and in some sections not much is left but the mere outline or ghost of the crystal.

(15) A specimen collected at a little digging by the Keeper's Pool, at Sutton, on account of the large number of felspar crystals, the absence of visible quartz, and the presence of a good many flakes of black mica, presents a very different aspect from that of the felsites already mentioned, and we find that under the microscope the same differences are apparent. The felspars are to a very great extent unaltered, and both orthoclase and a plagioclase are present. The mica occurs in good quantity, and has sometimes undergone a change into a pale green substance, which also has replaced hornblende, the shape of the original mineral being retained.

The ground mass is very finely micro-crystalline.

In the next group of felsites we have still different structure.

(16) In a pebble, from Catspool, there is very decided flow structure in the ground mass, not straightforward streams, but presenting the crumpled up, damascened appearance, which denotes the attempt at mixture of two slightly different viscid magmas, becoming stiffer as they cool and are pressed on from behind by the flow of the mass. The quartz grains are small and numerous, and the felspar is much altered.

(17) A pebble (No. 87) from Sutton has porphyritic crystals of felspar almost perfectly fresh and transparent, and quartz containing in places beautiful glass cavities, with a bubble in each. The ground mass of the rock is spherulitic, passing in places into a micro-pegmatite of a clear mineral, which we may take to be quartz, and a dirty-looking substance, which probably represents felspar.

(18) In another pebble (21) from Blackroot Pool, Sutton, the appearance is such as we might imagine to be produced by the crushing and rolling out of such a rock as the last. The quartz grains are broken up into lines and strings, which have been recemented into continuous masses again, and the total aspect might almost be described as that of a gneissose felsite. That such has been the mechanical origin of the rock I do not, however, feel sure. The quartz contains many more fluid cavities, but they might be secondary. At the edge of some of the quartz the ground mass runs into it in a very peculiar manner, almost like the teeth of a comb, and a place or two exhibits a very fine cross striation in the arrangement of the components.

(19) By far the most curious specimen is from Catspool (No. 39). It has a somewhat gneissic look in the hand specimen, but without any very determinable foliation as to minerals. A thin section with a low power has a most wonderful similarity of aspect to a section of wood; the general lamination in the one direction being crossed by groups of browner parts almost at right angles. When examined with crossed nicols, the whole breaks up into areas of considerable size, which however do not polarise uniformly, but are subdivided again. All one of the larger areas may be on the whole dark, but the smaller portions which make obvious the longitudinal grain, so to speak, of the specimen may have various degrees of shading. No quartz is visible, the whole has very much the general look of a felspar which has been crushed out of shape.

Four specimens are exactly of the Wrekin type.

(20) One from Catspool (20) is exactly similar to the pale brown, finely flow-banded rock of the Wrekin itself.

(21) Another (18) from King's Heath is spherulitic, but not in very good condition; while

(22) A third (10) from King's Heath is precisely of the type of the splendid Lea rock specimens, but bleached to a pale yellow brown.

It presents the same spherulites with central quartz masses, often also with similar agate linings, the same microliths, and in a striking degree the very beautiful perlitic structure.

(23) A coarse ash from Catspool, might have come out of the quarry in the Lawrence Hill at the Wrekin. In addition to fragments of the spherulites as in the last specimen of fragments showing perlitic structure, there occur vesicular—or what has been vesicular—basalt apparently, the vesicles being now filled with a green mineral. Another fragment is andesitic in its character.

(24) The grey felsites I have principally met with on the southern side of the district, but a very greenish-grey rock, showing fine flow-banding, and occasional beautiful "flow" round included knots or crystals, was obtained at Hamstead. Another extremely similar, except in the absence of so many quartz grains and its rather less perfect flow structure, was collected at a little pit just by the tunnel, between Alvechurch and Tardebigg, at a place called on the Ordnance map Ox Leasows. The flow lines are accentuated by the presence of a greenish-blue mineral, with dichroism in many parts, changing to a pale yellow on rotating over the polariser. It certainly does not appear to have the very high double refraction of epidote, yet in its radiating habit of growth in the larger masses it has a good deal the appearance of this mineral.

(25) At Catspool was collected a beautiful grey felsite, with white spherulites all through it, plainly visible to the naked eye (No. 45).

The structure of the spherulites is not radial, but irregularly disposed brushes of crystals fill up the areas. They often include the minute crystals of felspar, which occur to a large extent in the ground mass of the rock. These are mostly very fresh and transparent, as are also the larger porphyritic crystals. The felspars are usually only simple twins, and do not show the repeated twinning characteristic of the plagioclases, but the fact that in a few cases symmetrical extinctions on each side of the composition plane were observed, proves the presence of plagioclase, which the angles observed would suggest to be oligoclase.

One of the larger felspar crystals shows extreme irregularity of outline; it has either been deeply eaten into by the still molten magma, or its growth was crippled.

(26) Of a somewhat different type is a specimen (44) which I found lying by the roadside on the road between Alvechurch and Blackwell.

In the hand specimen the ground mass is very similar in colour. Abundance of felspar crystals of $\frac{1}{8}$ to $\frac{1}{16}$in. long are visible, and a number of dark-coloured, elongated masses

running nearly parallel to each other through the rock give a well-marked flow structure to the specimen.

On a surface tangential to the flow they appear as broader plates.

Examined by the microscope in thin section they are of a rusty-yellow colour, and are composed of crystalline masses, the formation of which has apparently gone on from the edges. The substance has low double refraction and no visible dichroism, and seems to be what is generally called, for want of more knowledge as to its real nature, viridite. It has the appearance of filling cavities in the original rock.

The larger felspars are mostly striated, and are in fairly good condition.

The ground mass is mainly composed of interlacing felspar crystals of minute size, but among them are the appearances of a residual glass, now devitrified and showing a pale indefinite mosaic between crossed nicols.

(27) A thoroughly good gneiss (28) occurs among the Sutton pebbles. It is composed of quartz, felspar a good deal decomposed, and a pale mica.

In one part of the section lines of inclusions run almost all across the slide at nearly right angles to the foliation, showing their origin to have been subsequent to the formation of the gneiss.

(28) Of somewhat similar character is a pebble from Sidnal farm (49).

It is coarser in grain, but consists essentially of quartz felspar and white mica. The foliation is not by any means marked.

It contains a number of collections of black, quite opaque grains, which show no crystal form, and give no indication of their nature.

(29) A dolerite occurs at Catspool, and also in one or two other places in the district near (46).

It contains olivine, and differs from the Rowley Rag by being ophitic in structure.

At Sidnal farm the little gravel pit furnished, in addition to the rocks already mentioned, a very coarse conglomerate of quartz and felspar fragments set in a finer matrix. The felspar appears to be orthoclase, and shows wonderfully brilliant cleavage planes.

At Catspool a pebble of red granite, and one of a red syenite were found, and one of slate traversed by a quartz vein.

At the Ox Leasowes pit a mass of chert, with casts of encrinites, was found very similar to those which are met with at Sutton.

Some less determinable pebbles occur in all the various pits, but require much more examination.

I had hoped to have found in the nature of the pebbles some criterion by which the drift pebbles might be distinguished from those of the Triassic pebble beds. The data for such a discrimination are, I fear, not yet sufficiently numerous to make an opinion worth very much, but I think that the presence in a bed of the grey felsites, or pebbles of the type of the Wrekin rocks, would afford strong presumption of later age.

The striking feature of the Triassic pebbles is the abundance of tourmaline in several different forms of rock. Dr. Lapworth tells me that there is a marked absence of tourmaline in the chain of the Scandinavian Mountains. as well as in its British extension in Northern Scotland, while we know that tourmaline rocks are very abundant in Cornwall and Devon, and also in the remains of the Great Southern Mountain Chain more to the east, with which the rocks of those counties appear connected. It will be remembered that in the series of Norwegian rocks brought home by Mr. Pumphrey this summer, there were none containing any tourmaline, or, at least, none in which it was an essential constituent.

It appears, threefore, as if we might on the whole look to the great southern ancient range of mountains for the origin of the Triassic pebbles, but there is nothing to show from how far south the rivers came which brought them down. The absence, or at least very great rarity of granite, would indicate that at that time the deeper-seated portions were not yet bared by denudation. On the other hand, we have specimens of the felsites which so frequently form off-shoots from granite masses, and from their micro-granitic texture we may infer that we have more than the *most* superficial parts of the felsites. The quartzites also would naturally occur more on the outer flanks of the range rather than in the interior parts. On the other hand, the crushed and laminated condition of some of the rocks shows that the processes of elevation and crumpling were well advanced; that we have not, as it were, the washings of the earliest stages of the mountain-making period.

The pebbles mixed with this southern type in the upper gravel beds are much more distinctly of the character of the Welsh and lake country rocks. Granite is more frequent, and slate and gritty ashes occur which are quite wanting in the undoubtedly Bunter deposits. In addition, there is the marked difference between the types of felsites which has been noted above.

The indentations so frequent in the Triassic pebbles may, of course, and in fact do, survive when the disturbance of the beds at a later epoch has not been very great, but if we observe the actual beds, the correspondence of the pits on pebbles which are in contact prevents any mistake as to the age of the deposit.

As at the beginning of these notes, so now I again call attention to the very fragmentary character of what I have brought forward. The pebbles from Cannock and Kinver still have to be examined, although Professor Bonney has, of course, worked at the former locality. In such an investigation, more almost than in any other petrological work, "adventures are to the adventurous," or, rather, any worker may, at any time, come across a new piece of information, in the shape of a pebble, by no merit of his own, but simply by the fact of its not having been bared before.

At any rate I have shown that there are a fine series of rocks to be found by anyone even in our apparently uninteresting pebble beds.

Review.

The British Moss Flora. Part XII. *Fam. X., Grimmiaceæ II. Fam. XI., Schistostegaceæ.* By R. Braithwaite, M.D., 303, Clapham Road. 7s.

This part, which concludes the monograph of British Grimmiaceæ, contains forty-seven pages of letterpress and seven plates, with descriptions and illustrations of twenty-five species and twelve varieties, both descriptions and illustrations being characterised by the exactness and finish that have been peculiar to this work throughout. In dealing with the difficult genus Orthotrichum, the author divides the species into two sections, by means of the stomata to be found upon the walls of the capsule. Sect. 1, *Gymnoporus*, includes those species in which the stomata are superficial, the gourd cells being naked and visible. Sect. 2, *Calyptoporus*, includes those species in which the stomata are immersed in the wall of the capsule, and more or less covered by some of the epidermal cells. These bodies, which are abundant on the capsules of some species, form a ready means for separating nearly-allied forms, and the importance of this new feature in the diagnosis will commend itself to all students of this difficult group. The excellent illustrations which are given of the stomata peculiar to each species will be found very useful as aids to determination.

The genus Weissia, *Ehrhart*, follows this, and contains those species of the Orthotricheæ characterised by having leaves with plain margins, twisted when dry, and placed by the older botanists, Wilson and Schimper, in the genera Orthotrichum or Ulota, but Ehrhart's name, Weissia, has priority. The part concludes with a description and full page illustration of the pretty little Cavern Moss, Schistostega Osmundocea.

This part, which is one of the most helpful and valuable portions of the author's great work, completes one-half of the whole work.

J. E. Bagnall.

Wayside Notes.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.—The annual meeting took place at Oxford on Tuesday and Wednesday, September 24th and 25th, but so close to the time of our going to press that our report of the proceedings cannot appear until November.

THE SYNTHETIC PHILOSOPHY.—Mr. F. Howard Collins, of Edgbaston, has for some years past been engaged in epitomising the ten volumes in which are contained all that is published of Mr. Herbert Spencer's Synthetic Philosophy. The arduous work is now completed, and will be published about the middle of October in a handsome volume. This epitome has been prepared with Mr. Spencer's hearty approval, and he has written an interesting preface to it. We shall review this important book in an early number.

PUPA ANGLICA (FER) IN CARMARTHENSHIRE.—Several specimens of this species were sent me last year from near Langharme, in this county, by Mr. G. W. Mellors. The species is new to the county; the only previous Welsh record, I believe, is for Anglesey. The specific name *anglica* is here given instead of *ringens* (Jeff.), because it has priority and is the name now used in the National Collection.—J. W. WILLIAMS.

A SPECIMEN OF PALUDINA CONTECTA (MILL) WITH A DOUBLE PERITREME.—In a batch of *P. contecta*, which Mr. Mayfield has kindly sent me alive, from Norwich, for dissecting purposes, I find one dead and empty shell which is worthy of note. The peritreme is double, each division being complete and divided from its fellow by a space of about 0·25 mill. I can get a fine probe between the divisions for the length of a millimetre; at this distance from the aperture the two divisions join. The inner division formed the aperture at the time of the death of the animal, as is evinced by the fact that it is more produced than the outer one. Unfortunately, the operculum is missing.—J. W. WILLIAMS, Mitton, Stourport.

DIFFERENCES BETWEEN THE EMBRYONIC SHELLS OF PALUDINA VIVIPARA (LINN.) AND P. CONTECTA (MILL.).—The configuration of the shells of the young of our species of land and fresh-water Mollusca should be more studied, for often it is a hopeless task—to even the most experienced conchologist—to give a definite and positive answer to which a young specimen should be referred out of two or more species. The young forms of these two species under note are very different and characteristic. In *P. vivipara*, when the little animal is extracted, the shell is hyaline and unbanded, the spire is very depressed, the body-whorl is slightly globous and slightly keeled. Comparatively speaking the peritreme is large, and, though somewhat obliquely placed, is more at a right angle to the body-whorl than in the adult shell. The special feature is the great depression of the spire. In *P. contecta*, on the other hand, the young shell shows distinct traces of its future banding; the spire is not depressed, but characteristically elevated, the apex is sharp, the body-whorl globous, in a ratio with *P. vivipara* as 5-2, and the upper portion of the peritreme comes off from the body-whorl at a right angle. The operculum of *P. contecta* is more depressed at its centre than that of *P. vivipara*. The distinctness specifically of *P. contecta* and *P. vivipara* has been many times disputed, and is not yet laid to rest. I have examined a large number of the embryonic shells of these two species,

and were they specifically one and the same, I should certainly have expected to have found not one, but several, of them taken from *P. contecta* agreeing with those characteristic features of shell I have just enunciated as found in *P. vivipara*. I have never found one such, and I have carefully searched. And this, I hold, is a very good reason to believe in the specific distinctness of the two forms, no matter what the internal anatomy may be of the adult forms. No one can appreciate the striking difference of shell-form in the embryos of these two forms unless they see them.—J. W. WILLIAMS, 35, Mitton, Stourport.

IN THE NORTH WARWICKSHIRE CAMBRIAN SHALES, at Chapel End, a bed of blue slate has been discovered. It is about 3ft. thick, and contains fossils. *Olenus*, *Agnostus*, &c., have been found. The dip is 54 degrees, same as the rest of the shales. This blue slate possibly indicates that the Warwickshire Cambrians are more nearly related to the Charnwood Rocks than has hitherto been supposed.—W. ANDREWS.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION MEETING, September 3rd, 1889. The President, Mr. W. B. Grove, M.A., in the chair. Mr. A. H. Martineau exhibited *Atticus pavonia major* (the Great Emperor Moth), from Ilkley, Yorkshire; Mr. W. B. Grove, M.A., *Agaricus lampropus*, from Sutton; and for Mr. W. R. Hughes, F.L.S., *Sphærotheca Castagnei* (the Hop Mildew); *Coleosporium Senecionis*, and *Polystigma rubrum*, from the south of England, and some of them under the miscroscope. Mr. S. Walliker, a large collection of Mosses, Hepaticæ, and Lichens from Germany, some of which were very fine, especially the Cladonias amongst the Lichens.—BIOLOGICAL SECTION, September 10th. Mr. W. B. Grove, M.A., in the chair. Mr. J. Udall exhibited *Drosera rotundifolia* in fruit from Stourport; also, for Mr. J. T. Blakemore, a hen's egg weighing ¼lb. Mr. W. H. Wilkinson exhibited the white variety of *Calluna vulgaris*, from Sutton Park, where the heather is unusually fine and abundant this year. Mr. Bagnall exhibited, for Mr. J. B. Stone, F.L.S., *Boletus edulis*, *B. scaber*, *Agaricus rubescens*, *Calocera viscosa*, and other fungi, from Rhyl; also, for Miss J. R. Gingell, *Drosera intermedia*, *Cuscuta epithymum*, *Hypericum elodes*, and other rare plants, from Cornwall; also, for Mr. Walliker, *Diphyscium foliosum*, *Pogonatum aloides*, and a number of other mosses, from the Riviera. Mr. Grove exhibited, for Mr. Oliver, *Polyporus vitreus*, from Edgbaston. Mr. J. Edmonds exhibited *Peltigera canina*, a foliaceous lichen, from Arley.—GEOLOGICAL SECTION, September 17th. Mr. W. R. Hughes, chairman. Exhibition of specimens. (1) Mr. J. E. Bagnall, for Mr. W. R. Hughes: A number of plants from South Devonshire, including *Anagallis cærulea*, *Calamintha officinalis*, *Erigeron acris*, *Aster tripolium*, &c. (2) Mr. J. E. Bagnall: *Silene anglica*, a rare colonist; *Russula heterophylla*, *R. depallens*, *Cantharellus aurantiacus*, and other fungi, from Coleshill. (3) Mr. W. H. Wilkinson: A collection of plants from Ramsgate district, including *Lepidium draba* (the hairy cress), *Hyoscyamus niger* (henbane), *Reseda lutea* (cut-leaved mignonette), also an abnormal form of Canterbury Bell, *Campanula Medium album*, in which the stem was much fasciated, and thirteen flowers combined into one long and folded bell; also a sponge, *Halichondria oculata* (Johnstone), from the shore near Sandgate, Kent.

DIAGRAMS ILLUSTRATING THEORIES OF HEREDITY

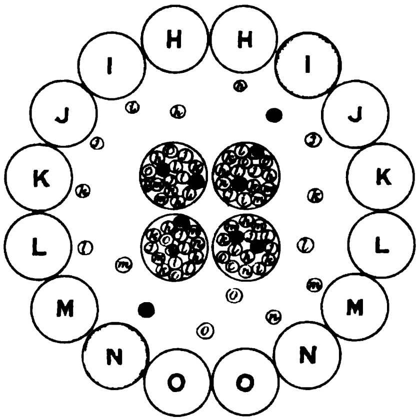
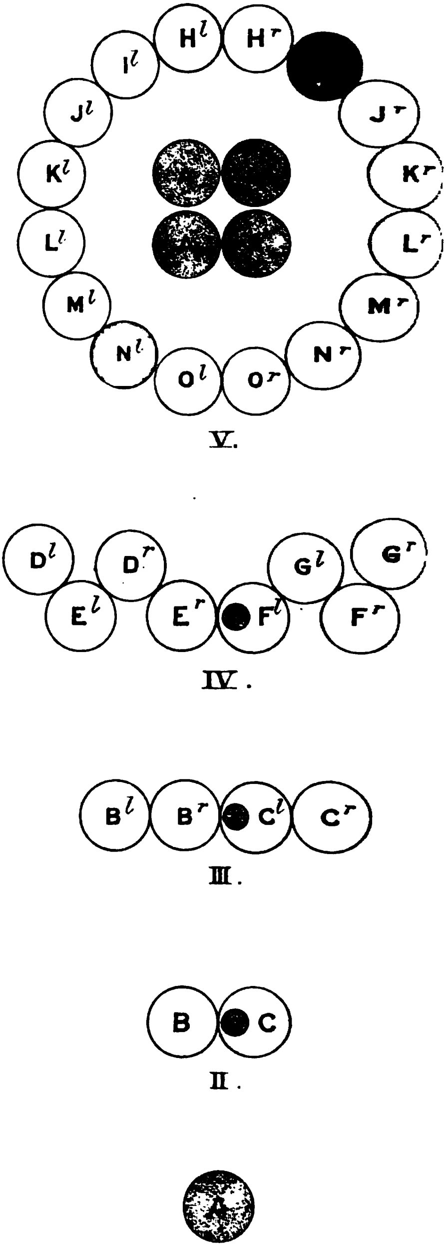


DIAGRAM I.

PANGENESIS.



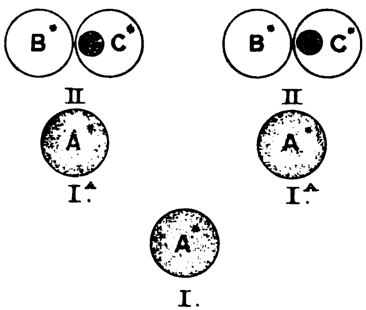


DIAGRAM III.

DEVELOPMENT OF IDENTICAL TWINS.

DIAGRAM II.

CONTINUITY OF GERM-PLASM

THEORIES OF HEREDITY.*

BY E. B. POULTON, M.A., F.R.S.,

PRESIDENT OF THE MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

In order to understand the problem of heredity, it is necessary to have some general idea of the manner in which the higher organisms are built up. The lowest organisms (Protozoa and Protophyta), both animal and vegetable, consist of single cells, while all higher animals and plants (Metazoa and Metaphyta) are composed of cell aggregates. A single Protozoon does not represent a single Metazoon, but one of the generally innumerable units of which the latter is composed.

The higher animals are, however, something more than aggregates of cells; they are cell-republics, in which, at any rate in health, the structure and function of the units are subordinated to the good of the whole. Certain diseases are due to the literal *insubordination* of some of these units, which grow and multiply in defiance of that relationship in proportion and in the consumption of nutriment, which is necessary for the well-being of the whole. The surest hope of successful treatment lies in an early extirpation of the centre of insurrection. Later on, the centre will not only grow, but will despatch agents along the channels of communication, setting up other centres of mischief in distant parts of the body. Such a republic is not only liable to destruction from within by the revolt of its own members, but also by the successful attack of enemies from without. Numerous other forms of life are ever seeking to obtain a lodgment within it, and, if successful, discomfort, disease, or death, is almost invariably caused. The larger enemies, or parasites, have been known for ages; while the smaller, but far more dangerous foes, the germs of disease, have only been appreciated in comparatively recent times. Now, however, they attract a very large amount of attention, and the germ theory of disease is probably the most fruitful advance ever made in the history of medical and surgical science.

The cells, or units, which compose the body of one of the higher animals differ greatly in structure according to the

* Read at the Annual Meeting of the Midland Union of Natural History Societies, held at Oxford, September 23rd, 1889. [The Report of this Meeting, together with the discussion on the President's Address and the Annual Report of the Union, will appear in our next number.—Eds. M. N.]

part they play in the economy of the organism. Thus, in man, the upper skin, or epidermis, is composed of layers of cells, becoming horny scales on the surface. These cells are continuous with those lining the digestive tract and which pass up the ducts into the various glandular organs. The connective tissues which bind the various structures together and which make up many parts, such as tendons and the lower skin or dermis, are also composed of cells and fibrous elements derived from cells. The supporting tissues, bone and cartilage, are also composed of cells and structures derived from cells; and the same is true of the great contractile tissues, striped and unstriped muscular fibre, and of the elements of the nervous system—nerve-cells and nerve-fibres. Out of many of these elements the complex organs are built up, with the addition of peculiar or specific cells of their own.

All the varied units which compose the metazoan body may be classified under two chief heads. There are the cells which are concerned with maintaining the life of the individual—the *body-cells* or *somatic cells*; and there are those which are concerned with maintaining the life of the species —the *reproductive cells* or *germ-cells.*

In the higher animals, the latter are aggregated in a comparatively limited area, the reproductive organs (ovaries or testes). These can be removed in the operation of castration without essentially affecting the somatic cells. The life of the individual continues to its normal length under these circumstances, but the succession of individuals is entirely prevented.

The problem of heredity may be stated as follows:—How is it that a single germ-cell can produce, by repeated division, an organism in which the peculiarities of the somatic units of the parent are reproduced? A single cell separates from a small area in the body of the parent, but it controls the development of the offspring, so that the characters of every part of the parent are repeated with more or less accuracy.

It seems that there are only two possible ways in which this marvellous fact can be explained. First, the whole of the somatic cells may be so intimately connected with the germ-cells that each of the latter bears within itself the influence of the whole of the former—an influence, too, of such a nature as to lead to the reappearance of the corresponding somatic cell in the course of development; clearly, therefore, an influence of a material nature. Secondly, we may look upon the germ-cells as directly developed from the germ-cell from which the parent arose. Parent and offspring

would then resemble each other, because they are developed from the same thing, although at different times.

There is an essential difference between these two theories of heredity. In the first, the germ-cells may bear the impress of every event which happens to the somatic cells during the life of the parent, and such characters may therefore be looked for in the offspring; in the second, offspring and parent can only resemble each other in characters which were predetermined in the germ-cell from which the parent arose. These latter characters, the peculiarities of any somatic cell which follow from the structure of the original germ-cell, have therefore been called *blastogenic* by Weismann. They have also been called *spontaneous*, because they spring up in the individual without reference to the causes which operate during its lifetime; also *inherent* or *centrifugal*, because they belong to the essential nature of the individual, and because they may be looked upon as developing from within rather than as impressed from without. Conversely, the characters which appear in the somatic cells as the result of external influences, or as the outcome of their own special or unusual activities,—in fact, any characters appearing in the body which were not predetermined in the original germ-cell, have been called *somatogenic*, because their origin cannot be traced to the structure of the original germ-cell, but is entirely due to events brought about in somatic cells; they are also called *acquired*, because the individual comes to possess them, although they do not belong to its essential nature; and *centripetal*, because they are impressed upon the individual from without, and are not the outcome of internal causes.

It is my object to give a more detailed account of these two theories of heredity, and then to very briefly allude to some of the evidence which is believed to establish the hereditary transmission of *acquired* or *somatogenic* characters.

The first theory, maintaining that a close relationship of a material kind exists throughout life between somatic and germ-cells, was suggested by Darwin, under the name of Pangenesis.

This theory is illustrated by Diagram I., in which the large circles, indicated by the capital letters H to O, represent the somatic cells of a Metazoon, which, for the sake of simplicity, is supposed to be composed of only sixteen somatic and four germ-cells, the latter being placed in the centre. The somatic cells are arranged in pairs, H H, I I, &c., in order to indicate the fact that similar cells are generally found on opposite sides of the body in the higher Metazoa (bilateral symmetry).

The fact that each germ-cell, placed under appropriate conditions, will develop somatic cells like those of the parent, is explained by the supposition that all the latter cells give off gemmules, which are stored up in the germ-cells. The gemmules are represented in Diagram I. by the small circles marked with the small letters *h* to *o*. The gemmules are seen to be traversing the space which separates them from the germ-cells, and also stored up in the latter.

The space between the circle of somatic cells and the central germ-cells in the diagram is left for the sake of clearness: of course there is nothing corresponding to it in the body. The germ-cells are nevertheless localised, and the *distance* which the gemmules would be compelled to travel in order that, *e.g.*, the change in a brain-cell may be registered in a germ-cell, would be far greater than that represented in Diagram I.

With this hypothesis every somatic cell is a germ-cell, while the germ-cells proper are merely the meeting place for the germs of somatic cells. Because every part of the body is thus supposed to reproduce itself, Darwin called his hypothesis Pangenesis. Each germ-cell is supposed to be, as it were, an extract of the whole body; a microcosm, in which every cell that takes part in the composition of the organism is represented.

The first difficulty which this hypothesis encounters is the almost infinite complexity of a germ-cell which contains a material particle, a representative or gemmule, from every somatic cell of one of the higher animals. The countless number of cells in the human body may be imagined from the fact that it would require over ten million red blood corpuscles, lying flat, one deep, to cover an area one inch square. And yet every single blood corpuscle, although not exactly a cell itself, is the product of a single cell.

But this is not all; for we must also suppose that each of the cells of every stage of development is also represented in each germ-cell, and is the material cause of the reappearance of such stages when the germ-cell itself undergoes development.

Nor is this all; for we are also compelled to believe that gemmules from the cells of large numbers of generations of ancestors are present in many germ-cells, accounting for the facts of atavism or "throwing back." When an animal "throws back" to some remote ancestor, the gemmules must have been handed down in a dormant condition through all intermediate generations.

There are also practical difficulties in the way of the acceptance of Darwin's hypothesis. If it were true, we should

expect that mutilations, especially such as were inflicted early in life, would be transmitted to offspring ; for all the cell-generations later than the date of the injury would be absent, and therefore unrepresented by gemmules. But there is no evidence in favour of the transmission of mutilations, however early they may be inflicted. All the evidence when carefully examined points in the opposite direction.

Furthermore, in the process of transfusion, when the blood of one individual is replaced by that of another, it seems reasonable to suppose that, if the gemmules exist, many of them would be carried over, and would collect in the germ-cells of the individual which received the blood, and that thus some characters of one individual would afterwards appear in the offspring of another. Careful experiments, conducted by Galton and later by Romanes, prove that such transference of hereditary characters does not accompany the transfusion of blood.

Not only may blood be transfused, but various tissues may be grafted and will thrive on another individual, or even on a very different species. In these cases, too, we should expect that such transferred tissues would produce effects upon the offspring, for, according to the hypothesis, they would continue to give off gemmules. No such hereditary influence has ever been traced or even rendered probable.

When we enquire why Darwin was led to frame such a hypothesis, which, in spite of its great merit in connecting together a number of apparently isolated facts, has so much to be said against it, we find the answer in a reply to one of Huxley's letters, in which Pangenesis had evidently been adversely criticised. Darwin says ("Life and Letters," first edition, 1887, Vol. III., p. 44): "I do not doubt your judgment is perfectly just, and I will try to persuade myself not to publish. The whole affair is much too speculative; yet I think some such view will have to be adopted, when I call to mind such facts as the inherited effects of use and disuse, &c."

This opinion of Darwin's is as true to-day as when it was written (about 1865, exact date uncertain). If the effects of use and disuse are transmitted, the explanation must be sought for in a hypothesis constructed on the same lines as Pangenesis. But if we are mistaken in believing that such transmission occurs, a far simpler hypothesis will account for the facts.

The manner in which the transmission of such effects can be explained by the hypothesis of Pangenesis is shown in Diagram I. Two of the somatic cells, I on the right side and N on the left, are dark coloured. This is to represent some change which has been wrought in their structure by

the influence of an external force, or by some unusual exercise or practice of a part. Thus I might represent the change which occurs in a bone-cell when a bony growth has been caused by long-continued pressure; N might represent the change which occurs in a nerve cell when some new habit is acquired by long practice. Such altered cells would originate correspondingly altered gemmules, indicated by the same dark appearance, which would be stored up in the germ-cells, and would reproduce similarly altered cells in the offspring.

I have given a very brief account of the main features of the hypothesis of Pangenesis. It is a hypothesis which would explain the hereditary transmission of acquired characters. At the same time it is beset by difficulties which appear to be well-nigh insuperable.

We will now proceed to examine another theory of heredity, that of Professor Weismann. The theory is called "The Continuity of the Germ-plasm," the latter name being applied to the essential part of the germ-cell which determines its development into an individual. The word "continuity" is made use of to express the theory that heredity depends upon the fact that a minute quantity of this germ-plasm is reserved unchanged during the development of the individual. and subsequently grows and gives rise to the germ-cells. Hence the germ-plasm is continuous from one generation to another in an unending succession, and from it the germ-cells of each generation are produced.

The germ-plasm in a germ-cell possesses such a constitution that, placed under appropriate conditions, an individual of a certain species will be produced; but the germ-cells of this individual will also contain the same germ-plasm, and will therefore develop into offspring which resemble the parent. Parent and offspring resemble each other because both arise from the same substance, which develops rather later in the case of the offspring. Hence everything which is predetermined in the germ-cell, every blastogenic character, may be transmitted, while somatogenic characters cannot be transmitted.

The theory will be rendered more intelligible if we refer to Diagram II., in which the development of a Metazoon like that shown in Diagram I. is represented, according to the theory of the continuity of the germ-plasm. Development is complete in five stages, the number of the somatic cells being doubled in every stage, after their first appearance in the second. The first stage (I.) is the fertilised ovum, A, the single cell out of which all others are produced. It contains germ-plasm from two individuals, the combination being

the process of fertilisation. The germ-plasm is in reality only found in the nucleus of the cell, but this is omitted from the diagram for the sake of simplicity. The germ-plasm is supposed to be represented by the dots in the circle A.

The second stage (II.) is produced by the division of the ovum into two cells (B and C), each of which will give rise, by subsequent division, to one of two great classes of somatic cells. This is no theory: it rests upon many observations. When the subsequent history of each cell has been watched in certain animals, it has been found that different classes of cells have been produced. Hence, by the division of the ovum A, two cells are produced which are unlike each other and unlike the ovum; the process is not merely one of halving, but of differentiation. This is important to bear in mind, because halving sometimes occurs and leads to very different results, as will be seen below. But Weismann also supposes that a minute part of the germ-plasm in the ovum escapes the process of differentiation, and is carried unchanged in one of the cells of the second stage. It is represented as the smaller circle A, enclosed within C.

Not only are cells separated very early to form the great classes of somatic cells which will afterwards appear, but the sides of the body, and its hind and front ends, are also soon determined. It appears that, in some animals, the great groups of cells are determined by the first division; in others the right and left sides, or front and hind ends of the body; while the cells giving rise to the chief groups on each side would then be separated at some later division. This is not theory but fact; for Roux has recently shown that, if one of the products of the first division of the egg of a frog be destroyed with a hot needle, development is not necessarily arrested, but, when it proceeds, leads to the formation of an embryo from which either the right or the left side is absent. When the first division takes place in another direction, either the hind or front half was absent from the embryo which was afterwards produced. After the next division, when four cells were present, destruction of one produced an embryo from which one-fourth was absent.*

Hence either the great groups of cells or the sides or ends of the body may be predetermined in the first division of the egg; and we may feel sure that, although the order varies in different animals, *both* results occur very early. In Diagram

* My attention was first directed to these interesting experiments by Professor Windle's paper in the "Journal of Anatomy and Physiology," Vol. xxiii., p. 393.

II., merely as an illustration, the first division is represented as producing the precursors, B and C, of two great groups of cells, while the second division gives rise to Stage III. in which the right and left sides of the body are determined. (The hind and front ends of the body are omitted from consideration for the sake of simplicity.) Thus B splits up into Bl and Br, which are the precursors of one of the great groups on the left and the right sides of the body, respectively. C similarly becomes Cl and Cr, the precursors of the other great group on either side of the body. One of the latter, Cl, carries the unchanged germ-plasm, A, originally derived from the ovum.

At the next division eight cells are produced (Stage IV.), and subordinate groups are predetermined on both sides of the body. Thus Bl gives rise to two cells, Dl and El, the precursors of the two subordinate groups into which the chief group afterwards divides on the left side of the body. Br similarly divides and initiates the corresponding subordinate groups on the right side. Analogous divisions are undergone by Cl and Cr. In one of the products of Cl, viz., Fl, the unchanged germ-plasm is passed on.

The fourth division produces the fifth and last stage, the complete organism. Each of the eight cells again divides, producing sixteen cells, arranged as eight pairs. The body is, therefore, made up of eight different kinds of somatic cells, each kind being represented on both sides of the body.

The process may be summed up as follows:—In the first division, Stage II., one of the two chief groups of somatic cells, viz., H, I, J, K, on both sides of the body, was predetermined in B; and the other chief group, L, M, N, O, was predetermined in C. At the second division, Stage III., the separation of these two chief groups for the right and left sides of the body was determined. Bl became the precursor of Hl, Il, Jl, and Kl; Br of Hr, Ir, Jr, and Kr, and similarly with Cl and Cr. At the third division, Stage IV., the separation of the two chief groups into subordinate groups on either side of the body was predetermined. Thus Bl gave rise to Dl and El, the precursors of the subordinate groups Hl, Il, and Jl, Kl respectively: similarly with the others. Finally, in the last division, Stage V., each subordinate group again separates into two kinds of cells, thus making eight different kinds altogether.

This is a very imperfect attempt to realise by an appeal to diagrams the course of development in a Metazoon. The imperfection lies chiefly in the simplicity of the illustration as contrasted with the inconceivable complexity of the actual

process. Many facts, however, seem to show that the *principle* of development is correctly indicated in the diagram.

At about the time of the last division we must suppose that the minute mass of germ-plasm, A, grows and separates as a germ-cell or germ-cells from either Fl or one or more of the somatic cells into which the latter divides. The four germ-cells of the adult Metazoon are then produced by division. These germ-cells are, therefore, similar to that which started development; they are, in fact, a piece of it, which has grown without undergoing any essential alteration. The development of these four germ-cells will, therefore, produce offspring resembling their parents.

If, however, some of the somatic cells become modified from that nature which was predetermined in the germ-plasm of the ovum, there is no way in which the hereditary transmission of such effects can be explained by the theory of the continuity of the germ-plasm; for the theory does not include any means by which the effects could be conveyed to the germ-cells, or, if conveyed, could produce in them changes such that similar effects would be predetermined in the corresponding somatic cells of the offspring. The acquired changes in Ir and Nl, indicated by their dark colour, would be confined to the organism in which they arose, and would not affect its offspring, at any rate in a corresponding manner.

If the transmission of acquired characters were proved to be an undoubted fact, Weismann's theory of heredity would inevitably collapse. It cannot, however, be maintained that such proof is yet forthcoming.

The question largely turns upon an exact knowledge of the proportion borne by blastogenic to somatogenic characters. We know how important a share of our physical and mental qualities are hereditary. It would, therefore, follow, if Weismann's theory be correct, that blastogenic characters are far more important than somatogenic.

There is some evidence that this is the case, and I will here bring forward one line of proof, because it also supports the conclusion alluded to above, that the whole organism is predetermined in the ovum.

If this last conclusion be valid, it follows that the differences which characterise individuals are predetermined in the ova from which they arise, that ova are not alike any more than individuals. We do, however, occasionally meet with individuals so much alike that we (incorrectly) speak of them as "identical." The resemblance between certain twins is far closer than that between other members of the same family. If, therefore, we can prove that such "identical"

individuals are derived from "identical" ova, the above-mentioned arguments and conclusions will receive very strong support.

"Identical" twins are invariably of the same sex. When twins are of different sex, the degree of resemblance is no greater than that between brothers and sisters generally. This is also true of many twins of the same sex, and Galton has brought forward evidence to show that they may even differ more widely than is usual with brothers or sisters.

It has been long known that twins of the same sex are often enclosed in the same embryonic membranes, while twins of opposite sex are always enclosed in separate membranes. The latter would be the product of distinct ova, which had been separately fertilised, as in the ordinary multiple births of animals (cats, dogs, rabbits, &c.). The former would be the product of a single ovum, which has divided into two ova, in all probability after fertilisation. But it is clear that the ova arising from the two halves of a single ovum, at a time when the individual characteristics were already determined, would be very nearly identical: their resemblance would be of a very different order to that of separate ova. We also find that twins of the same sex present resemblances of a very different order to that of brothers or sisters generally, who are developed from separate ova. It must be admitted, therefore, that there is a very high degree of probability that the "identical" ova are those which develop into the "identical" individuals. The interesting conclusion that sex is also predetermined in the fertilised ovum also follows from the same facts.

The probable beginning of the development of "identical" twins is shown in Diagram III. A* is a fertilised ovum with the individual characteristics predetermined; it is, therefore, different from A in Diagram II., and is distinguished by the asterisk. At its first division A* does not form the cells of Stage II., which, it will be remembered, are different from each other and from the ovum; but it divides without differentiation into two equivalent cells, like each other and like the ovum. Hence the first division of A* does not produce Stage II., but Stage Iᴀ, consisting of two similar ova. Each of these then divides, as in Diagram III., forming a true Stage II., comparable to that of Diagram II. After this the other stages succeed as in the latter, and finally two individuals will be formed, which must resemble each other if it be true that individual characteristics are predetermined in the fertilised ovum. And, as a matter of fact, such resemblances are seen in individuals whose development may be considered,

with a very high degree of probability, to have followed the lines indicated in Diagram III.

The amount of resemblance has been shown by Galton,* who traced the after life of about eighty "identical" twins as far and as completely as possible, obtaining instructive details in thirty-five cases. Of the latter there were no less than seven cases "in which both twins suffered from some special ailment or had some exceptional peculiarity;" in nine cases it appeared "that both twins are apt to sicken at the same time;" in eleven cases there was evidence for a remarkable association of ideas; in sixteen cases the tastes and dispositions were described as closely similar. These points of identity are given in addition to the more superficial indications presented by the failure of strangers or even parents to distinguish between the twins.

When the lives of twins were followed in after years "in some cases the resemblance of body and mind continued up to old age, notwithstanding very different conditions of life." In other cases "the parents ascribed such dissimilarity as there was wholly, or almost wholly, to some form of illness."

The conclusions of the author are as follows:—"Twins who closely resembled each other in childhood and early youth, and were reared under not very dissimilar conditions, either grow unlike through the development of natural characteristics which had lain dormant at first, or else they continue their lives, keeping time like two watches, hardly to be thrown out of accord except by some physical jar. Nature is far stronger than nurture within the limited range that I have been careful to assign to the latter." And again "where the maladies of twins are continually alike, the clocks of their two lives move regularly on, and at the same rate, governed by their internal mechanism. Necessitarians may derive new arguments from the life histories of twins."

Mr. Galton also met with twenty cases of twins (also of the same sex) in which the differences were greater than those which usually distinguish children of the same family. In such twins the conditions of training, &c., had been as similar as possible, so that the evidence of the power of nature over nurture is strongly confirmed. Mr. Galton writes, "I have not a single case in which my correspondents speak of originally dissimilar characters having become assimilated through identity of nurture. The impression that all this evidence leaves on the mind is one of wonder whether nurture can do anything at all beyond giving instruction and professional training."

* Journal of the Anthropological Institute, 1875, p. 391 and p. 325.

The argument thus leads to the conclusion that nearly everything which is characteristic of an individual is blastogenic, and therefore can be transmitted by the continuity of the germ-plasm. We can thus appreciate Weismann's contention that natural selection, while seeming to decide between successful and unsuccessful individuals, is in reality deciding between successful and unsuccessful germs.

Monstrosities can be satisfactorily explained, in the same manner as "identical" twins, by the occurrence of an equivalent division instead of a differentiating division of the cell which, at some stage of development, is the precursor of the doubled part. It has already been shown that when the ovum of a frog divides in a certain direction, one cell is the precursor of the future front half of the body, the other of the future hind half; for if one of them be destroyed the corresponding half is absent. Similarly, if one of them underwent equivalent instead of differentiating division, a monster with two front parts or two hind parts would be produced.

During the vast succession of differentiating divisions which take place in the development of one of the higher animals, the cells which represent parts of less and less importance are gradually told off. Thus, each finger and toe might be represented by a single cell at some period of development; and if one of these underwent equivalent divison, such a simple monstrosity as the occurrence of a supernumerary digit would be accounted for.

The facts are in reality more complex than appears in this description; for I have only considered the differentiating divisions which are concerned with producing the various parts of the body, and there are also the other differentiating divisions which produce the various groups of cells found in each part. Taking these into account also, we see that each finger would be represented by a single cell for each of the great groups of cells which will take part in its constitution. These cells must all undergo equivalent division, for we find all the groups of cells represented in each of the two parts formed in a double monstrosity.

It must be remembered that in such a case the fertilised ovum possessed such a structure as to predetermine an equivalent instead of a differentiating division at that particular point. And we know that such monstrosities are in the highest degree hereditary, as they would be if the germ-plasm were continuous.*

* See Professor Windle's interesting papers on Teratology, published during the last few years in the "Journal of Anatomy and Physiology," and the "Proceedings of the Birmingham Philosophical Society."

Repair, and the renewal of lost parts in certain animals, is also explained by the persistence of the cells which were the immediate precursors of that part or tissue;—cells which would be ready to pass through the last stages of development under the stimulus provided by an injury.

The simplicity and beauty of Professor Weismann's theory of heredity commends it to our favourable attention, and demands a searching enquiry into the evidence for the supposed transmission of acquired or somatogenic characters.

Into this enquiry it is impossible to enter on the present occasion. I will only mention the various lines of evidence which require investigation. The evidence may be either Direct or Indirect. Direct proof would be afforded if an undoubtedly somatogenic character could be shown to have reappeared in the offspring sufficiently often to prevent its explanation as a coincidence. Thus, if mutilations, or the pure results of training, exercise, or education (as apart from predisposition), or acquired diseases (many diseases are certainly blastogenic) reappeared in the offspring as the result of the operation of heredity, the required proof would be afforded and the theory of the continuity of the germ-plasm would collapse. Many diseases are due to living organisms ("germs"), and when these reappear in the offspring the result is clearly due to inoculation of the embryo or even the germ-cell (as in the silkworm disease), and is not therefore due to the operation of heredity.

The present adverse position of the medical faculty is in part due to want of discrimination between blastogenic and somatogenic characters; in part to the fact that the evidence on which they rely was collected when the transmission of somatogenic characters was assumed by everyone; and in part to real difficulties which, however, require the most careful re-examination before they can be accepted as proofs of the transmission of acquired characters and as the death-blow to Weismann's theory.

If the Direct evidence for the transmission of acquired characters fails to stand the ordeal of a thorough investigation, the Indirect evidence still remains. If it could be shown that certain phases of evolution would have been impossible *without* such transmission, we should be compelled to maintain that the latter had taken place.

The chief lines of Indirect evidence are:—The fact of individual variation, the effects of use and disuse of parts, the facts presented by the phenomena of instinct.

Individual variation was believed to be due to the hereditary effect of the direct action of environment. It is known that in some cases (*e.g.* certain plants) variation has been caused by the direct action of environment on the germ-cells while still contained in the body of the parent. Such a change is, of course, blastogenic, and would be transmitted. There is less evidence for the operation of such causes in the case of animals. The consideration of twins and monstrosities pointed to the conclusion that individual variation is predetermined in the fertilised ovum. If it be asked how such differences between ova are produced, Weismann has pointed out that there is some evidence that the changes which ova and spermatozoa undergo, as a preparation for their fusion in fertilisation, must lead to individual differences. He, therefore, considers that variation is produced by sexual reproduction, and is, in fact, its *raison d'être*. The meaning of this form of reproduction is to supply variations upon which natural selection can operate.

The apparent effects of increased use are more probably due to the operation of natural selection upon a part which is, *ex hypothesi*, of especial importance, combined with the admitted increase which follows increased use during the life of the individual. The apparent effects of disuse are more probably due to the cessation of natural selection, which can no longer maintain the efficiency of a useless part. All functional parts of an organism are kept up to a high standard by the operation of natural selection; withdraw selection and degeneration will at once begin. It is very interesting to find that both Galton and Weismann independently arrived at the conclusion that this offered a *better* explanation of the gradual dwindling of useless parts, than that afforded by the supposition that the admitted dwindling which follows from disuse during an individual life is transmitted.

Finally, the phenomena of instinct seem capable of explanation by the operation of natural selection upon blastogenic variations of the nervous system, rather than by the supposed transmission of acquired habit. In many cases we are compelled to adopt the former theory, and it is open to us in all.

I have not really attempted any discussion of the transmission of acquired characters. I have only indicated the chief lines along which the discussion has been and will be directed.

THE SYNTHETIC PHILOSOPHY.*

BY GRANT ALLEN.

Every Midland naturalist, it is to be hoped, has long before this read Mr. Herbert Spencer's "Principles of Biology." Not to have done so is to remain in the dark ages of pre-Darwinian thought. That great work forms, indeed, the foundation of the science of life in its modern development; and to rest ignorant of it is to ignore contentedly what the most fertile of our thinkers has had to say about the kernel of our own particular subject. *Noblesse oblige*: and much is expected of Midland naturalists. Yet. great as the Biology is in itself, it becomes even greater still when viewed as a component part of the vast and harmonious fabric of the Synthetic Philosophy. Fully to understand the book, it must be taken as succeeding the "First Principles," and as leading up to the "Principles of Psychology." And, if we wish to gain a clear conception of animal life, at least, in its total manifestations, we must have read the account of the evolution of nervous systems given in that part of the Psychology entitled "Physical Synthesis," as well as the account of the evolution of other structures and functions given in the morphological and physiological parts of the "Principles of Biology." The naturalist's world cannot well be isolated from the rest of the great universe of which it forms one important component element. As part of a whole itself, its philosophy can only be rightly grasped in connection with the philosophy of the cosmos which embraces and includes it.

Mr. Spencer has fully impressed upon our generation this profound truth, and has illustrated it himself in his wonderful life-work. But not to all men is it given to follow him equally through all the fields of thought his architectonic mind so impartially traverses. Many of us would at least like, as Mr. Spencer himself puts it. "a small outline map;" and in the small outline-map we can more readily find our way on a first exploration than in the detailed plan, or in the intricacies of the actual country to be travelled. Such a map Mr.

* "An Epitome of the 'Synthetic Philosophy.'" By Howard Collins. With a Preface by Herbert Spencer. (London: Williams and Norgate. 1889.)

Collins has prepared for us with infinite patience. skill, and labour. He has gone through the ten published volumes of the "Synthetic Philosophy," part by part, chapter by chapter, section by section, paragraph by paragraph, and has given us the gist and kernel of each, at the uniform rate of three lines to each page of the original, with a success that really surpasses belief. To say that any man has epitomized another with such mathematical regularity sounds at first hearing as if he must have taken all the life and colour out of his author's work—as if the result must be a purely dull and mechanical copy of a living whole. Nothing could really be further from the truth. Mr. Collins's summary is both truthful and readable; it contains in brief every leading thought or argument of the original, but it contains it in a form scarcely less vivid than Mr. Spencer's first presentment. Only a reader who thoroughly entered into his author's meaning could so impartially represent in brief so vast a body of propositions on so many varied subjects. Mr. Collins is to be congratulated on having succeeded so well, and in having obtained from Mr. Spencer himself the high commendation of an introductory *imprimatur*.

For the student, the great value of the summary now set forth will be its use as an aid to the anticipatory reading of the "Synthetic Philosophy." Before tackling any particular one of those wonderful volumes, he will do well to read over carefully at full length the whole of Mr. Collins's epitome of its contents by gradual stages. He should then begin, chapter by chapter; and, before reading each, should peruse the corresponding portion of the epitome. In the same way, each paragraph should be looked up in the epitome beforehand, so that the train of thought and the tendency of the argument may be clearly appreciated. Finally, at the end of each part, the whole corresponding portion of the epitome should be re-read in a lump. so as to recall to the mind vividly the course of the thread of thought through the entire distance just traversed. This may seem to lazy people a painfully serious way of going to work; but, then, the "Synthetic Philosophy" is a serious undertaking, and if ever a book was worth reading with care, many times over, surely it is this highest and widest product of the human scientific and philosophical intelligence. A great thinker has been born among us. Let us accept with gratitude the work he has done himself, and all the aids that others have given us in understanding and elucidating his orderly arrangement of the vast chaos of materials Nature presents to the observing intellect.

THE FLIGHT OF BIRDS AND INSECTS.

BY EDMUND CATCHPOOL, B.SC.

(Concluded from page 225.)

If, as I have tried to make clear, an insect when moving forwards is partly supported by that motion, as well as by the vibration of its wings, it follows that it is easier for it to fly forwards than to remain in one place in the air, and it is easily shown by experiment that this is the case. If we catch a bluebottle fly, and cut away the hinder two-thirds of each wing (so as to leave the front rib with about one-third of the original surface attached), we shall find that it can no longer balance itself in the air, nor, if placed on the ground or on a table, can it rise; yet, if dropped from a height of a few feet. though it cannot at first support itself, yet the active vibration of the remaining portions of its wings soon gives it a forward motion, and as this becomes more rapid the fly falls less and less rapidly, then moves forward horizontally, without falling, and, finally, takes an upward slope, reaching the window, perhaps, at a higher point than it started from. Here we see not only that the forward motion helps to support the insect, but that this support is obtained with less expenditure of strength than the same amount obtained by the vibration of the wing alone, since the fly is not strong enough to support itself, with its diminished wing-surface, by the latter method. It is easy to see why; for the upward pressure resulting from the continuous forward motion is a continuous pressure acting always on the same side of the wing, and is, therefore, subject to none of the losses from want of rigidity and change of direction, which, as I have pointed out, waste much of the energy expended in the vibratory motion of the wings. We see, then, that a fly, when its wings are partly cut away, is forced to economise its strength under this disadvantage by using the vibration of its wings to propel it, instead of only to support it, and taking advantage of the support which its forward motion gives it. Now, the fly's wings, so reduced, are still more than eight times as large in proportion to its weight as those of a pigeon, and nearly twenty times as large in proportion to its weight as those of an albatross. The wings of a pigeon, to be as large in proportion to its weight as those of a gnat, must be nearly 6ft. each in length, and wide in proportion. And the bird, though rather stronger in proportion to its weight than the insect, is not much stronger; probably not half as strong

again. (The widely prevailing idea that insects are enormously strong in proportion to their weight can be shown, I think, to be a fallacy, resulting from a misconception of what increased strength, with proportionately increased mass, ought to effect.) So that it is certain that the bird must use the most economical method of flight available. Now, we found that a fly, forced by the reduction of its wing-surface to greater economy of strength in flying, was still able to fly if it turned its wing-surfaces into an oblique position, moved them obliquely instead of horizontally, and, using them thus as propellers as well as supporters, took advantage of the upward pressure arising from its forward motion. It is evidently only a further step in the same direction to place the wing-surfaces nearly horizontal, and move them vertically. In this case the pressure of the wings on the air is directly backwards, and does not support the insect at all; the whole support is derived from the gliding of the wings, sloping a little up in front, on the air. This seems to be the principle of the flight of the larger insects, of bats, and of birds.

If we examine the wing of a bird, we find that it consists of two distinct parts, though they are not always separated by a distinct line. The part nearer the body of the bird consists of feathers which are divided nearly into equal parts by the ribs, are directed backwards along the bird, and overlap so that no air can pass between, at least from below. The outer part, that furthest from the body, consists of feathers which, when the wing is outstretched, are nearly at right angles to the body, and separate from one another like the outspread fingers of a hand, and consist each of a flexible surface supported by a stiff rib which runs very nearly to its front edge. Each of these outstretched feathers, then, is stiff along its front edge, and flexible along its hinder one, and it is easy to see that, as it is moved up and down, the resistance of the air will always set it in such a position that, if it tries to move edgewise, it will tend forwards. That, as a matter of fact, each of these feathers does act as a propeller, can easily be shown by fixing two of them to a clockwork arrangement which makes them move up and down as they do on the bird, and which is suspended from a small carriage which can run along a horizontal string. As soon as the feathers begin to move up and down, the carriage runs forward along the string; and that such a propelling power as these feathers furnish is all that is necessary for flight, is shown both by the fact that a bird can support itself in the air simply by holding its wings outspread as long as its forward motion lasts, and could therefore do so indefinitely with the aid of a propelling

force. This can be shown by a simple experiment. If we bend a piece of cane into a bow, cover it with paper so that it forms a crescent-shaped surface similar to that offered by the outstretched wings of the bird, we find that it will glide forwards on the air just as a bird does, and if it is furnished with screw propellers, like those of a steamship, driven by an elastic spring, it will continue this gliding motion till the spring is run down.

Such a model as this makes very clear the two distinct functions of the wing: propulsion and support. The propulsion must be the work of the long outer feathers, for the others, besides being unfitted for it by structure and arrangement, do not move up and down far or rapidly enough; the support, which in this method of flight continues when the wings are merely extended, is especially the part of the continuous surface formed by the overlapping feathers nearer the body. It is, indeed, only for convenience that these move up and down at all; as our model shows, if the propelling feathers could move up and down while the inner part of each wing was merely outstretched, the resulting flight would be the same.

It will be noticed that in the smaller insects, which support themselves entirely by the motion of the wings, almost the whole of the wing-surface is at the end remote from the body, since only at the end of a long arm can it be moved through sufficient air in each stroke to make it effective. Where the support is afforded by the forward motion of the whole animal, as in the larger moths and all birds, every part of the wing serves equally for support, and the largest part of the surface is, therefore, near to the body, as being the position in which it can be supported with least material.

Now, let me recapitulate. The typical insect flight, that is seen in perfection in small insects such as gnats, when hovering in still air, is effected by putting the wing-surfaces vertical, and moving them horizontally; the support results from the motion of the wings, and ceases with it. The typical bird flight, on the other hand, is effected by placing the wing-surfaces nearly horizontal (but slightly higher in front), and moving them vertically, this propels, but does not support, and the support results from the forward motion, and lasts, even if the wings stop, till the forward motion ceases. But, on the one hand, every insect, when it moves forward, adopts to some degree the bird principle of flight; and, on the other hand, most birds occasionally support themselves, even in still air, without moving forwards, and, in this case, they place their bodies nearly vertically, and move their

wings nearly horizontally after the manner of insects. Pigeons often balance for a few seconds in this way, and almost all small birds, and the humming bird for much longer periods; but it is, as I have shown, a wasteful action, and it would be impossible but for the power, which all animals have, of exerting for a few moments an amount of energy many times greater than that which they can continue to exert for several consecutive hours. It is known that a man can exert, for a minute at least, ten times the average energy per minute of his day's work, and it is probable that a pigeon balancing in still air is doing much the same. But the larger birds, with even smaller wing-surface in proportion to their weight, are not able to do this even for a few moments; they can support themselves only by moving forwards through the air, and when they want to remain in the same place they can only do it by flying slowly against the wind, so that the wind carries them back as fast as they fly forwards, or, if there is no wind, by flying round and round in circles. Such birds, when there is no wind, cannot rise from the ground until they have acquired some forward velocity by running, and the albatross, whose wing-surface is only half as great in proportion to its weight as the pigeon's, cannot even acquire sufficient velocity in this way, and, except in a wind, cannot rise from the ground at all.

This subject, the relation of wing-surface to powers of flight, is itself a very extensive one, and it cannot be dealt with, even in the most elementary way, without mathematics, so in this paper I have assumed, without proving, that large animals have a smaller wing surface in proportion to their weight than small animals, and that this smaller wing surface is a disadvantage from the point of view of economy of work in flight.

NOTES ON SOME ROCK SPECIMENS COLLECTED IN NORWAY BY MR. C. PUMPHREY.*

BY MR. T. H. WALLER, B.A., B.SC.

The collection of rocks which Mr. Pumphrey has put into my hands for examination and description consists of a considerable number of specimens from various localities visited by Mr. Marshall and himself between Bergen and the North Cape.

* Transactions of the Birmingham Natural History and Microscopical Society, read 16th October, 1888.

As might be expected they almost all belong to the highly metamorphic rocks which go by the names of gneiss and schist. Of these there are several varieties. On the one hand, there are specimens which in the two or three inches square which their surfaces afford are not distinguishable from granites, as they show none of the foliation which characterises the gneisses. From these there is a gradual passage to the most intensely foliated specimens which have plainly been submitted to immense shearing and rolling strains. The schists are mostly of that stage of formation in which the original constituents are not utterly lost, but only crushed, twisted, and utterly deformed, while secondary micas have formed in discontinuous layers among the fragments.

These crushed and rolled rocks have exactly the aspect of many of those from the N. W. Highlands, with the elucidation of which the name of Professor Lapworth is so closely identified. There is a pure hornblendic gneiss which almost absolutely resembles some specimens of the grey Hebridean gneiss of the Scotch district.

Of these rocks I have cut one section—from a reddish gneiss rock which yet showed by its generally rather dull aspect and the obvious knots of felspar that it had not arrived at the fully recrystallised stage of metamorphism.

Examined microscopically this structure is still more striking, and the use of polarised light shows almost every felspar grain crushed and twisted, and in by far the greater number of cases affected with the peculiar cross twinning which is characteristic of microcline, but which has been of late suspected as being specially developed where felspar crystals have been subjected to great crushing. It will be remembered that Professor Judd has proved that the ordinary twinning so frequent in plagioclase is often confined to those parts of a crystal which have been strained by being bent or crushed, and that even in quartz changes of molecular structure equivalent to twinning have been brought about by the same means.

With this specimen I should like you to compare one from the pebble beds which are so largely developed locally. At least it is really from the upper gravel beds at Catspool, near Alvechurch, but I have no doubt it is derived from the washing of the older pebble beds. It has a very similar appearance, is, however, almost altogether felspathic, and shows none of the eyes of larger felspar grains, but a very curious lineation perpendicular to the foliation (which is much more marked in the hand specimen than in the section) is apparent, giving the look of a section of wood. This seems to be due to the

twinning of the felspar grains—I imagine probably due to pressure—but there has plainly been a certain amount of cleavage and slip among the grains.

The flaggy gneissose or schistose rock from Vic, which Mr. Pumphrey informs me is used as slates in the district, would probably afford very much the same appearances modified by the fact of being made out of a more basic rock.

Another specimen from which I have cut a section is that marked labradorite from the Nerodal—I think this should be called saussurite. It contains a few very shadowy grains of some plagioclase felspar, which still retain the twinning, but the greater part is made up of a mass of mostly interlaced crystals, very ragged at the edges, but apparently formed *in situ*. Some of these seem to extinguish when their length is parallel to one of the axes of the nicols prisms, but in many the extinction angle is about 20°; there is also an indistinct cleavage in some of the larger grains, but as these seem to give brighter colours with crossed nicols, I imagine it may be another mineral which is present. In "Teall's Petrography," under the head of saussurite, it is mentioned that this substance appears to be usually a mixture of some felspar with either zoisite or epidote. Cathrein, who has very thoroughly investigated the subject, considers that no distinction can be drawn between zoisite and epidote saussurites. Dr. Reusch has described a saussurite from near Drontheim, which mainly consists of epidote either quite colourless or pale greenish yellow, and shows twinning. I think that the composition of the specimen on the table must be much like this, but I have not yet been able to refer to the original memoir. The mass has arisen by the decomposition of a highly basic lime felspar, the zoisite or epidote using up the lime. The specimen is quite different from the saussurite of the Lizard, which I show for the purposes of comparison. The latter has a much more granular structure. As Mr. Teall says:—"Indeed it must be remembered that the term saussurite has no precise signification. It is merely employed to designate the dense light-coloured aggregates which arise in connection with the alteration of a basic felspar."

One or two other of the specimens should be noticed. One huge grained quartzite and one fine glistening one are completely analogous to two from the pebble beds of Sutton.

The specimens of dolomite are particularly beautiful, both the snow white one and that which displays on part of it such a lovely rose tint.

The soap stone of Drontheim appears to be a sort of talc-mica schist with no very marked foliation. There are a

good many of the specimens which would well repay careful examination. The schist from Bergen is exactly similar to one of the Highland series from Loch Tarbert, and would be very interesting in section.

It is worth notice that tourmaline appears to be, if not absent, very inconspicuous, so that, in spite of the similarity mentioned above between these rocks and some of our pebbles, the very widespread occurrence of tourmaline in the latter seems to separate them as a whole from the Scandinavian series.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL MEETING, October 1st. The President, (Mr. W. B. Grove, M.A.) in the chair; present twenty-one members. Messrs. G. Lavender, E. F. Spicer, and F. R. Goyne were proposed for membership. Mr. W. B. Grove, M.A., exhibited (for Mr. Caswell) a fungus growth from the surface of a vat of lime-juice. It was formed by the mycelium of *Penicillium glaucum*, and was coloured a brilliant crimson on the lower surface. Mr. T. E. Bolton exhibited under the microscope living specimens of *Plumatella repens* and *Cephalosiphon limnias*. Mr. W. R. Hughes gave an account of the recent meetings at Oxford of the Midland Union of Natural History Societies; supplemented by Messrs. R. W. Chase, K. Parkes, and W. H. Wilkinson. Mr. Herbert Stone then gave his paper "On a Disputed Point in the Structure of the Stomata of Plants." He gave the result of the examination of a large number of different leaves, which tended to prove the presence of the cistoma, of which he gave an enlarged drawing, and exhibited sections of leaves under the microscope, showing the cistoma *in situ*.—BIOLOGICAL SECTION, October 8th. Mr. W. B. Grove, M.A., in the chair. Mr. C. Pumphrey exhibited *Acanthus mollis*, from King's Norton. Mr. W. B. Grove exhibited *Russula fellea*, *R. adusta*, *Hydnum niveum*, *Agaricus imbricatus*, *Ag. galericulatus* var. *calopus*, *Cortinarius rigidus* (?), *C. caninus*, *C. ochroleucus*, and *C. anomalus*, from the neighbourhood of Sutton. Mr. J. Edmonds then read his paper "On Photography as an Aid to Natural History Studies," the many beautiful illustrations of which were exhibited by means of the limelight by Mr. Pumphrey.—GEOLOGICAL SECTION, October 15th. Mr. Waller, B.A., B.Sc., in the chair. An invitation from the Geological Section of the Philosophical Society was read, and attention called to the notices issued by the Selborne Society on the protection and preservation of plants and animals. Mr. Wilkinson exhibited moths, including *Chærocampa porcellus*, *Macroglossa stellatarum*, *Zeuzera Œsculi*, and *Pterophorus pentadactylus*, from Kent. Mr. Herbert Stone showed a solution of chlorophyll in alcohol, which, on exposure to light, exhibited alternately a beautiful transparent green colour and a port wine colour. Mr. Walliker exhibited specimens of quartz covered with pyrites, from Lake Superior. Mr. W. P. Marshall read a paper on "Singular Water-worn Rocks," met with in his recent trip to the Orkneys and Shetlands.

The paper was well illustrated by diagrams. Mr. Waller made some very interesting remarks further elucidating several points touched upon by Mr. Marshall. Professor Lapworth gave a learned exposition of the peculiar symmetrical shapes, with mouldings and ridges, into which the surface of the Old Red Sandstone splits up.—SOCIOLOGICAL SECTION, October 22nd. The first meeting of this section this session. Mr. W. R. Hughes, F.L.S. (President), in the chair. There was a large attendance of more than seventy members and friends, including many ladies. An address was delivered by Miss Constance C. W. Naden, of London, on "The Principles of Sociology," of Mr. Herbert Spencer, being the fourth division of the Synthetic Philosophy. The address, which occupied more than an hour in delivery, was listened to with marked attention, and was frequently applauded. At its conclusion a cordial vote of thanks was passed to Miss Naden, accompanied by a request that she would allow it to be printed, on the motion of the President of the Society (Mr. W. B. Grove), seconded by Professor Tilden, F.R.S. Professor Lapworth, F.R.S., J. A. Langford, LL.D., and Mr. F. J. Cullis, F.G.S., also addressed the meeting. Miss Naden's address will appear in the "Midland Naturalist."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 19th. Mr. Corbet exhibited a series of photographic views of the Giant's Causeway. Mr. J. Madison then read a paper, "Notes on a Holiday Ramble." The ramble commenced at Coventry, and was made for the purpose of visiting the field of Naseby, interesting from being the site of a great battle fought between the armies of Charles and Cromwell, and also the spot where the Stratford Avon rises. The places of interest passed through were Combe Park, Brinklow, Lutterworth, and Welford. Lutterworth was full of interest from its association with John Wycliff. The Avon takes its rise in a well, the stream being so small as to pass through a one-inch pipe. The return journey was made to Coventry through West Haddon, Hill Moreton, and Dunchurch. The paper was illustrated by a series of photographs taken during the ramble and shown as lantern pictures. At the close of the paper a series of photographs of the Aberystwith district, was shown by Mr. C. P. Neville.—August 26th. Mr. H. Hawkes showed an interesting collection of plants from the Chesil Bank, Weymouth; also cases or tubes of Terebella. Mr. J. W. Neville, a series of microscopical preparations of *Dytiscus marginalis*. The series comprised a number of larvæ, showing different stages of growth. Messrs. Deakin and Lilley, a large collection of Eocene fossils from Barton Clay, Hampshire.—September 2nd. Mr. H. Hawkes exhibited the following fungi:—*Fistulina hepatica* and *Spumaria alba;* Mr. Camm, *Trichia intermedia*, *T. scabra*, *T. Jackii*, and *Oligonema nitens*. Mr. Deakin. shark's teeth from Barton Cliff; Mr. Linton, a collection of fossils from Whitby. Under the microscope, Mr. J. W. Neville, mouth-organs of beetle *Ocypus olenus;* Mr. J. Moore, poison bag in jaw of spider.—September 9th. Mr. J. W. Neville showed twelve mounted slides of lepidopterous larvæ; Mr. H. Hawkes, five volumes of marine algæ, a collection made in Devonshire by Dr. William Arnold Bromfield. Under the microscope Mr. Hawkes showed the following fungi: *Erysiphe communis* and *Uncinula bicornis*.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

TWELFTH ANNUAL MEETING,

HELD AT OXFORD, SEPTEMBER 23RD AND 24TH, 1889.

With every augury of a most successful gathering, the delegates and members of the various scientific societies constituting the Union assembled at Oxford on Monday, September 23rd. As far as outside attendance was concerned, the Twelfth Annual Meeting was one of the very largest the Union has had. No doubt the intrinsic attractions of Oxford are great, and of these the Oxfordshire Natural History Society, the host for the occasion, availed itself to the utmost; no doubt specially strenuous efforts had been put forth, both by the host society and by the officials of the Union; but after making allowance for both of these agencies, the widespread interest in the successful maintenance of the Union, which was evinced by the attendance of sixty or more visitors, coming from centres so remote as Chester and Derby, was both satisfactory and gratifying. Amongst the visitors present at the meeting were Mr. R. W. Chase, Rev. Geo. Deane, D.Sc., Mr. W. R. Hughes, F.L.S., Mr. Geo. H. Kenrick, Mr. W. P. Ryland, Mr. and Mrs. John Rabone, Mr. and Mrs. Thos. Clarke, Mr. W. K. Parkes (Assistant Secretary of the Union), Mr. C. R. Robinson, Mr. Thos. H. Waller, B.A., B.Sc. (President of the Birmingham Naturalists' and Microscopists' Union), Mr. W. H. Wilkinson, Mr. W. B. Grove, M.A. (President of the Birmingham Natural History and Microscopical Society), Mr. Herbert Stone, Mr. F. Grimley, Mr. J. Kenward, F.S.A. (President of the Birmingham Philosophical Society), Miss Jermyn, Mr. and Mrs. Antrobus, Mr. T. V. Gardner, Dr. Lawson Tait, Professor Bridge, Professor and Mrs. Hillhouse, and others, of Birmingham; Mr. and Miss Shepheard, of Chester; Mr. Horace Pearce, F.L.S., F.G.S. (President of the Dudley and Midland Geological Society and Field Club), and Mrs. Pearce; Mr. S. D. Williams, and Mr. G. M. Stubbs, Sutton Coldfield; Mr. Francis Galton, F.R.S., of Leamington; Dr. Fitch, of Chaddesley, near Kidderminster (President of the Worcestershire Naturalists' Field Club); Rev. T. Auden, M.A. (President of the Severn Valley Naturalists' Field Club), Rev.

W. G. D. Fletcher, M.A., and Mr. Wm. Bedcall, Shrewsbury; Rev. P. M. Feilden, M.A. (President of the Oswestry and Welshpool Naturalists' Field Club); Mr. Beeby Thompson, F.G.S., Mr. W. D. Crick, Mr. A. and Mrs. Kempson, Mr. M. H. Holding, Mr. J. Shuttleworth, and Mr. T. Pressland, Northampton; Mr. R. S. Bartleet, J.P., and Dr. Wm. Smith, Redditch; Mr. E. de Hamel, Middleton Hall, near Tamworth; Mr. W. H. and M. Carl Duignan, Walsall; Mr. Isaac Knowles, Miss Bellis, Wellington; Mr. and Mrs. E. F. Cooper, and Dr. Finch, Leicester; Mr. H. A. Bemrose and Mr. G. Fletcher, Derby; while the Oxford Society provided a goodly number of attendants at the meetings, amongst whom were Mr. E. B. Poulton, F.R.S. (President, and President of the Union), Mr. H. M. J. Underhill (Secretary), and Mr. G. C. Druce, M.A. (Treasurer). Professors Westwood and Clifton, Drs. Collier, J. A. H. Murray, M.A., Sankey, and E. B. Tylor, F.R.S.; Sir John Conroy, M.A., Revs. F. J. Smith, M.A., J. W. B. Bell, M.A., J. G. Burch, B.A., Messrs. D. H. Nagel, M.A., H. Balfour, M.A., Arthur Sidgwick, M.A., W. W. Fisher, M.A., V. H. Veley, M.A., M. S. Pembrey, B.A., P. C. Mitchell, B.A., O. H. Latter, B.A., J. Woods, and many others. For the comfort of the visitors the most careful arrangements had been made. Many were most kindly and hospitably entertained at private houses, and the chief cause for regret on the part of the host society was their inability to provide similar accommodation for the whole of their visitors.

The visitors gathered in the University Museum at about two p.m., and while the members of the Council held their annual meeting, those who were not officially occupied were formed into small parties and conducted over Oxford. In the University Museum, the Pitt-Rivers Collection (Anthropology), Mr. H. Balfour, M.A., kindly explained points of special interest, and in the Hope Collection (Insects), Professor Westwood directed attention to the most interesting features, while in the Central Court of the Museum, the Collections illustrating Comparative Anatomy and Osteology, the Secondary Fossils, and the Primary Fossils in the Grindrod Collection, which are especially fine, were open to inspection. The Bodleian Library and Camera, the Ashmolean Museum (Archæology), the Clarendon Press, and the Botanical Gardens, Museum, and Library were also open to visitors.

The Annual Meeting of the Council was held at 2 30, the following being present:—Mr. E. B. Poulton, M.A., F.R.S. (President), in the chair, Mr. R. W. Chase, Rev. G. Deane, D.Sc., Rev. P. M. Feilden, M.A., Mr. W. B. Grove, M.A., Mr.

E. de Hamel (Treasurer), Prof. Hillhouse, M.A., F.L.S., Mr. W. K. Parkes (Assistant Hon. Secretary), Mr. H. Pearce, F.L.S., F.G.S., Mr. C. R. Robinson, and Mr. H. M. J. Underhill. The report of the adjudicators for the Darwin Medal, and the Annual Report were received, discussed, and adopted for presentation to the Annual Meeting, and a recommendation to the Union to appoint a committee to consider the affairs of the Union with especial reference to the privileges of the component societies and their relations with the "Midland Naturalist" was also passed.

From half-past three to half-past four afternoon tea was served in one of the galleries of the Museum, after which the

GENERAL ANNUAL MEETING

was held in the large Lecture Theatre of the Museum, under the presidency of Mr. E. B. Poulton, M.A., F.R.S., the attendance being exceptionally large. After a few words of welcome from the President, the minutes of the last meeting were taken as read, and the Secretary read the following

REPORT OF THE COUNCIL OF THE MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Societies which are now members of the Union are as follows: –

Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Leicester Literary and Philosophical Society.
Malvern Field Club.
Northamptonshire Natural History Society.
Oswestry and Welshpool Naturalists' Field Club.
Oxfordshire Natural History Society and Field Club.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.

The Council very much regret to report that the Northamptonshire Natural History Society, under whose auspices the Annual Meeting of last year was held, have decided to withdraw, after this year, from the Union. Negotiations are, however, on foot with the Birmingham Entomologists' Society for their affiliation with the Union This is a young society which is doing very valuable work in Entomology, and the Union hope that it will raise this study to a higher level in the Midlands than it has hitherto attained.

DARWIN MEDAL.

The subject for which the Darwin Medal is awarded this year is Geology, and the papers which have appeared in the "Midland Naturalist," and were eligible for the competition, were submitted to the following gentlemen, who had kindly consented at the request of the Council to act as adjudicators, viz., H. W. Crosskey, LL.D., F.G.S.; G. Deane, D.Sc., B.A., F.G.S.; Professor J. W. Judd, F.R.S., F.G.S.; Professor Charles Lapworth, LL.D., F.R.S., F.G.S.; J. J. H. Teale, M.A., F.G.S.; and W. W. Watts, M.A., F.G.S.

The papers submitted to these gentlemen were as follows:—

"The Middle Lias of Northamptonshire," by Beeby Thompson.

"The Geological Structure of Titterstone Clee Hill," by the Rev. J. D. La Touche.

"Niagara: its Physical and Geological Conditions," by W. P. Marshall.

"A Deep Boring near Birmingham"; "Faults in the Drift"; "Rocks of Cambrian Age at Dosthill"; "Deep Boring in Keuper Marls," by W. J. Harrison.

"Structure of Rowley Rag"; "Rock from New Zealand"; "Gold at Mount Morgan, Queensland"; "Micro-chemical Methods for Separating Minerals"; "Separation of Minerals by Heavy Solutions"; "Petrography of our Local Pebbles"; "Crystallization in Rocks"; "A Lithia-bearing Granite from South Devon"; "Notes on some Norwegian Rocks," by T. H. Waller.

"Inaccuracies in Leicestershire Geological Survey"; "Fossiliferous Hæmatite Nodules"; "Fossil Tree at Clayton"; "Stigmaria," by W. S. Gresley.

"Barium Sulphate as Cement in Sandstone," by F. Clowes.

Three of these investigations were picked out by the adjudicators for special mention, viz., those by Mr. Beeby Thompson, Mr. W. S. Gresley, and Mr. Thos. H. Waller; and of these, four of the adjudicators placed Mr. Waller first, one gave Mr. Beeby Thompson first place, and one bracketted these two gentlemen together.

Acting upon these reports, the Council have awarded the Darwin Medal for 1889 to Mr. Thos. H. Waller, B.A., B.Sc., for his researches upon Local Petrography.

Concerning these researches, Mr. Teale says, "Of Mr. Waller's work I am able to speak in the highest terms. All of it is valuable and accurate, and much of it is original." Professor Lapworth speaks of Mr. Waller's papers as "a remarkable list, . . . each of which embodies the result of a large amount of original work." Mr. Watts says, "Of the value of Mr. Waller's papers to petrologists it is impossible to say too much."

To the investigations of Mr. Beeby Thompson and Mr. W. S. Gresley the adjudicators are likewise almost unanimous in awarding high praise.

"Midland Naturalist."

The publication of the "Midland Naturalist" goes on regularly, and in the standard of the contributions there is no falling off. The principal papers are as follows:—The continuation of "The Fungi of Warwickshire," by W. B. Grove, B.A., and J. E. Bagnall, A.L.S.; the continuation of "The County Botany of Worcester," by Wm. Mathews, M.A.; the completion of "The Middle Lias of Northamptonshire," by Beeby Thompson; "Passages from Popular Lectures," by F. T. Mott, F.R.G.S.; "On the Successful Use of Oil to Calm Rough Seas," by W. P. Marshall, M.I.C.E.; "On Kew Gardens and some of the Botanical Statistics of the British Possessions," by J. G. Baker, F.R.S., F.L.S.; "The Physical Geography of the Past," by Horace T. Brown, F.G.S., F.I.C., F.C.S.; "Insularity," by Rev. H. H. Slater; "The Life History of a Myxomycete," by T. P. Blunt, M.A.; "Notes on a Tour in Norway and Collection of Plants," by W. P. Marshall, M.I.C.E., and C. Pumphrey; "The Foundations of our Belief in the Indestructibility of Matter and the Conservation of Energy," by J. H. Poynting, D.Sc., F.R.S.; "Notes on *Stigmaria*," by W. S. Gresley; "In Sherwood Forest," by Oliver P. Aplin; "Microchemical Examination of Minerals and the Separation of Rock Constituents by Means of Heavy Solutions," by T. H. Waller, B.A., B.Sc.; the Address of the President to the Birmingham Natural History and Microscopical Society; "Foraminifera of Oban," by E. W. Burgess; "On the Autumn Migration of Swallows and Martins," by W. Warde Fowler, M.A.; "The Work of Field Clubs," by Ch. Callaway, D.Sc., F.G.S.; "Wild Bees," by R. C. L. Perkins; "Professor Poynting on our Physical Beliefs," by Herbert Stone, F.L.S.; Book Reviews, by W. B. Grove, B.A., W. R. Hughes, F.L.S., and others; and a sympathetic Memoir, by W. R. Hughes, F.L.S., of his friend, the late Philip Henry Gosse, F.R.S.

The Council are glad to observe that this list includes the names of several members of the more outlying societies of the Union. They cannot but think that "The Midland Naturalist," as the official organ of the Union, might be much more widely made use of for the purpose of recording the transactions of the various societies in the Union than it has hitherto been. However laudable may be the desire on the part of larger societies in the Union to publish their own proceedings, they feel that this separate publication necessarily deprives the general scientific public of any cognisance of their work. From this point of view it would be far better that the Union should have one strong organ than that the various societies constituting it should each publish a separate journal of the work of its members.

There have been a number of papers of importance read before the societies in the Union who publish their own separate proceedings. The

Birmingham Philosophical Society's last published volume contains papers on "The Constitution of a Popular University," by Dr. W. A. Tilden, F.R.S.; on "The Extensor Tendons of the Manus of Apes," and "Congenital Malformations," by Dr. Bertram C. A. Windle, M.A.; on "The Collection and Use of Local Statistics," by Mr. J. Thackray Bunce, F.S.S.; "Suggestions for a Midland University," by the Rev. H. W. Watson, D.Sc., F.R.S.; on "The Distribution of Boulders in South Shropshire and South Staffordshire," by Mr. F. W. Martin, F.G.S.; on "The Cranial Anatomy of Polypterus," by Professor T. W. Bridge, M.A.; and by the same author a paper on "The Air-bladder in certain Siluroid Fishes;" on "The Suppression and Specialisation of Teeth," by Mr. J. Humphreys, L.D.S.I., and by Professor Poynting, D.Sc., "On a Form of Solenoid Galvanometer"; by Dr. H. W. Crosskey, F.G.S., on "The Glacial Geology of the Midlands."

The Northamptonshire Natural History Society and Field Club continue their interesting quarterly journal. Lord Lilford continues his "Notes on the Birds of Northamptonshire;" Mr. G. C. Druce, F.L.S., is still at work at the "County Flora;" Mr. Beeby Thompson, F.C.S., F.G.S., extends his exhaustive analysis of "The Upper Lias of Northamptonshire;" the Rev. H. H. Slater's address on "Insularity," is printed in No. 35 of the journal. Mr. Walter D. Crick contributes an article on "*Helix Pomatia* in Northamptonshire," to No. 36, which also contains some meteorological reports and observations.

The Transactions of the Leicester Literary and Philosophical Society are as interesting as they are varied. Mr. F. T. Mott, F.R.G.S., contributes papers on "The Native Trees of Leicestershire;" "The Ferns of Leicestershire," and "On Cultivation." Mr. W. A. Vice, M.B., has a contribution on "The Teeth in the Order Rodenta." An article by Mr. Montagu Browne, F.Z.S., on "The Antiquity of Man in Leicestershire," is accompanied by a number of excellent illustrations. Part X. contains contributions by Mr. T. Carter, L.L.B., on "The Parasitic Phanerogams of Leicestershire"; and by Mr. G. H. Storer on "The Habits and Voices of British Song Birds." In Part XI. Mr. H. G. Quilter discourses on "The Rhaetics of Leicestershire," and the Rev. T. A. Preston, M.A., on "Fruits." Mr. J. W. Knowles contributes a paper on "The Theories as to the Variations of Race in Mankind," and Mr. F. R. Rowley on "Facts concerning *Hypopus*." Literary papers on "Sartor Resartus," by Mr. J. D. Paul, F.G.S., and by Mr. A. H. Paget, on "The Beaumonts of Gracedieu," help to make the transactions of great interest.

During the year the General Honorary Secretary of the Union, Mr. Thos. H. Waller, B.A., B.Sc., has decided to resign his office, and the Council takes this opportunity of tendering to him their hearty thanks for the time and thought which he has given to the Union during the five years he has held that responsible post.

As to the general condition of the Midland Union, the Council cannot but feel that there is much to be desired. The Union has in the past done a large amount of most valuable work, and so far from believing that the days of its chief utility are over, the Council consider that, if its work is rightly directed, it can do much more in the future than it has done in the past.

In conclusion, the Council desire once more to draw the attention of the constituent societies to the growing custom of the separate publication of their proceedings. While they do not feel justified in

laying down any hard and fast rule, they cannot but believe that in most cases this separate publication is a serious error. They have already referred to this from the point of view of the general scientific public, but from that of the societies themselves they believe that the disadvantage is even greater. The burden upon the finances of the societies which publish is unduly great, much is published which does not justify its cost, and the range of distribution of that which is published is unduly restricted, while the interest of the meetings of the society is to a large degree discounted.

These matters the Council would commend to the most serious consideration of the members of the Union, and in the assured conviction that while it is no doubt true that to some extent a society exists for its members alone, it is equally true that for a society to not only preserve its vitality, but also preserve its youth and freshness, the range of its operations must be as broad as it can practically be made.

In completion of the Report of the Adjudicators and decisions of the Council and Annual Meeting, the President then presented the Darwin Medal for 1889 to Mr. Thos. H. Waller, B.A., B.Sc., in recognition of the value of his researches on Local Petrography, &c. After a few words of acknowledgment from Mr. Waller, the meeting approved the

TREASURER'S REPORT.

Dr. RECEIPTS.

		No. of Mbrs.	Rate.	£	s.	d.
1888. July 4th.	To Balance in hand ...			21	1	11
1889.	Rugby School Natural History Society ...	258	1	1	1	6
	Oswestry and Welshpool Naturalist Field Club ...	40	3	0	10	0
	Birmingham Natural History and Microscopical Society...	147	3	1	16	9
	Caradoc Field Club ...	60	3	0	15	0
	Oxfordshire Natural History Society and Field Club	73	3	0	18	3
	Northamptonshire Natural History Society...	150	3	1	17	6
	Leicester Literary and Philosophical Society ...	271	3	3	7	9
	Birmingham School Natural History Society ...	12	1	0	1	0
	Birmingham and Midland Institute Scientific Society...	184	1	0	15	4
	Birmingham Microscopists' and Naturalists' Society ...	30	3	0	7	6
	Dudley and Midland Geological and Scientific Society and Field Club ...	80	3	1	0	0
	Malvern Field Club ...	50	3	0	12	6
	Birmingham Philosophical Society ...	120	3	1	10	0
		1,475		£35	15	0

Cr. PAYMENTS.

		£	s.	d.
1888.	T. H. Waller, Secretary's Expenses ...	2	7	6
	J. Moore, Gold Medal ...	7	16	6
	,, Bronze ...	0	2	10
	Wright, Dain, Peyton and Co. ...	0	17	6
1889.	Wright, Dain, Peyton and Co....	2	8	11
	Treasurer, Postages, &c....	0	3	0
	Balance in hand ...	21	18	9
		£35	15	0

The Election of Officers then took place, Mr. E. de Hamel being re-elected Treasurer, and Dr. Lawson Tait and Mr. Kineton Parkes, Secretaries. A vote of thanks to the Officers of the past year was then passed, especial reference being made to the retirement of Mr. Waller from the post of secretary, which he had held for five years. A Committee, as follows, with power to add to their number, was appointed to enquire into the affairs of the Union, and its relations with the Midland Naturalist:—Mr. R. W. Chase, Dr. G. Deane, Mr. G. C. Druce, M.A., Mr. R. M. Dixon, Rev. P. M. Feilden. Mr. E. de Hamel, Professor Hillhouse, Mr. H. Pearce, Mr. E. B. Poulton, F.R.S., Dr. Lawson Tait, and Mr. Beeby Thompson.

The President then delivered the Address on "Heredity," printed at pages 245-58.

Mr. Francis Galton, F.R.S., spoke at considerable length upon the question, and referred to many of his own investigations, which had led him independently to the same conclusion as that adopted by Professor Weismann.

Dr. Collier stated that he should not have ventured to take part in the discussion had he not felt that some of the opinions advanced by Professor Weismann were opposed to the views held by the bulk of the medical profession. Mr. Poulton had told them that if Weismann's Theory of Heredity were true, it would not allow that acquired characters could be transmitted; but Dr. Collier asserted that the general opinion of the medical profession was that certain morbid changes in the tissues and organs of the body acquired during adult life might in some subtile manner be transmitted to the offspring, and render the offspring far more likely to develop the disease from which the father and mother suffered than would be the offspring of healthy individuals. He would take, as an example, gout. Let us suppose that a healthy man marries at thirty, leads a healthy life, and has two or three children. Between thirty-five and forty he then begins to indulge himself with the pleasures of the table, eats large quantities of animal food, drinks largely of the heavier wines, and at the same time takes very little exercise. As a result of this he develops a distinct attack of gout. Now experience proved that the children that might be born to such a man after he had developed gout would be far more likely to suffer from gout than were the children he had had previous to the development of the disease. Experience had

also shown that the children of gouty parents developed the disease generally some years earlier than their parents. For example, the father would have it at forty or fifty, the children at twenty to twenty-five. Further, the younger children were more liable to suffer than the elder. Now what was gout? It was known that the symptoms were due to an excess of uric acid in the blood. It was believed by many that this excess was due to some injury inflicted on the liver by over feeding and over drinking, which prevented it properly fulfilling one of its functions. that was the conversion of the nitrogenous portions of the food into soluble urea. Now most medical men would hold that this injury inflicted on the liver might in some subtile way be transmitted to the offspring, so that their livers bore as it were the imprint of their father's disease, and were therefore, when the slightest strain was thrown upon them, more likely to break down than were the healthy livers of other children. Again, take the case of consumption. It was known that something like thirty-five to forty per cent. of the children of one consumptive parent developed consumption, but when both parents suffered from it nearly a hundred per cent. developed and died of this disease. It was now known that consumption was due to the growth and development of a vegetable organism in the lungs. And medical men believed that the growth and development of this organism in the lung produced some change in it, the imprint of which change could be transmitted to the lung of the offspring, rendering the lung much more liable to be attacked by the organism than an ordinary healthy lung. Another example he might give was that of hæmophilia, a disease characterised by immoderate bleedings; so that patients suffering from this disease would bleed spontaneously, or the slightest cut or the removal of a tooth would be followed by bleeding so severe and so difficult to arrest as to endanger life. Now it was held that this tendency was due to some subtile change in the walls of the blood-vessels which rendered them much weaker than the walls of healthy vessels, but the way in which the disease was transmitted was exceedingly interesting. The disease descends to the boys through the mothers, the women remaining quite healthy. Thus, one boy of a family of six acquires the disease, he marries, his sons and daughters are apparently healthy and do not suffer, but the disease again appears among the male children of his daughters, and so on from generation to generation. One other point he would like to mention, and

that was his surprise that Professor Weismann had apparently paid so little attention to the difficulties which the transmission of hereditary diseases would seem to offer to this theory of heredity, while he had devoted a whole lecture to disprove the supposed transmission of mutilations. For he, Dr. Collier, felt sure that hardly a medical man could be found, and very few of the general public, who ever thought that the effect of mutilations, such as scars, or removal by accident (or otherwise) of portions of the body, were in any way transmitted to the offspring.

Professor Hillhouse proposed a vote of thanks to Mr. Poulton for his address. After referring to the fact that besides those of Darwin and Weismann, there existed two other important theories of heredity, those of Nägeli and of Strasburger, he pointed out cases existent in the vegetable kingdom which were not readily explicable by the Weismann theory, which theory he looked upon as in large degree unnecessary. The resolution was seconded by Dr. Lawson Tait, who supported the view of Dr. Collier as to the transmission of acquired characteristics, and further enforced the case of hereditary bleeding as one in point; and a lively passage of arms arose between Dr. Tait and Mr. Francis Galton, owing to the trenchant criticism by the former of the use of the word "heredity."

The vote having been carried, the proceedings closed with a hearty vote of thanks to Mr. H. M. J. Underhill, Secretary of the Oxfordshire Natural History Society, for the admirable arrangements he had made for the meeting of the Union.

CONVERSAZIONE.

By the kind permission of the University Delegates the Conversazione in the evening was held in the University (Ashmolean) Museum. About 700 guests were present, and they were received by the President, Mr. Poulton, and Mr. Underhill, the Secretary of the host society. In addition to the remarkable collection of varied and interesting objects with which the great Museum and the Pitt-Rivers Museum are filled, a programme for the amusement and instruction of the visitors was provided, the wealth of which our space only enables us in the briefest way to depict. In the Large Lecture Theatre in the North Gallery, Dr. E. B. Tylor, F.R.S.,

gave to an overflowing audience a series of demonstrations illustrating savage methods of procuring fire, and Mr. Henry Balfour, M.A., discoursed on bows and arrows, and described a series of specimens illustrating the Lapland Whale Fishery. The Radcliffe Library (West Gallery) was open during the evening, by kind permission of the Librarian, Sir Henry Acland, K.C.B., D.M., F.R.S.; as also was the Court of the Clarendon Laboratory, by kind permission of Professor R. B. Clifton, F.R.S., where he, assisted by Mr. Walter R. Clifton, exhibited acoustical apparatus in the Lecture Room of the Laboratory. The Hope Collection of Insects (South Gallery), unrivalled in certain departments, was, by kind permission of Professor J. O. Westwood, M.A., exhibited and explained by himself, the Rev. J. W. B. Bell, M.A., and Mr. Arthur Sidgwick, M.A. In the Central Court of the Museum, the Rev. F. J. Smith, M.A., showed some recent forms of apparatus employed in physical research; by kind permission of Professor W. H. Jackson, M.A., Mr. O. H. Latter, B.A., exhibited microscopical preparations and living specimens of various animals, and Mr. P. C. Mitchell, B.A., showed the working of microtomes and the methods employed in the preparation of microscopical sections. Mr. G. C. Druce, M.A., displayed a collection of the grasses of Oxfordshire, and Mr. J. B. Farmer, B.A., described and illustrated a method by which Algae, &c., may be grown upon a microscopic slide, and also showed some botanical specimens. The anthropometric apparatus of Mr. Francis Galton, F.R.S., was also exhibited; while in a side room the Rev. J. G. Burch, M.A., showed his interesting perspective microscope. In the South Corridor, Mr. W. W. Fisher, M.A., showed some brilliant fusion experiments with oxygen, and Mr. V. H. Veley, M.A., also showed chemical experiments. In the Geological Lecture Room in the South Corridor, Mr. M. S. Pembrey, B.A., performed some physiological experiments. In the Lecture Rooms in the South Gallery, Sir John Conroy, M.A., showed some experiments on fluorescence, and Mr. D. H. Nagel, M.A., experiments with sensitive flames. In the Large Lecture Theatre (North Gallery), Mr. H. M. J. Underhill exhibited, with the oxy-hydrogen lantern, coloured slides of his own preparation representing the microscopic organisms from the ponds and rivers near Oxford, and others illustrating a Japanese legend of some evolutionary interest, the beauty of the slides being much appreciated. The Conversazione did not close till nearly midnight.

TUESDAY.

Arrangements had been made on this day for an excursion to Shotover Hill, where Mr. Poulton had proposed to deliver a discourse upon the geology of the district. From an early hour, however, it was seen that the weather would make any attempt of this kind a disastrous failure, and, much to the regret alike of hosts and guests, it had to be abandoned. With ready courtesy, however, the Ashmolean Museum was opened, and Mr. Balfour, who had undertaken to give up his afternoon to the guests, most courteously sacrificed his morning also. To this museum most of the visitors made their way, and examined, at greater leisure than had been possible on the previous evening, its invaluable contents, while Mr. Balfour explained the most interesting items in the Pitt-Rivers Anthropological Collection, and Professor Westwood talked over his favourite butterflies and moths.

At about one o'clock a company, numbering between eighty and ninety guests, sat down to luncheon in the Hall of Christ Church, where an excellent collation was provided. The President (Mr. E. B. Poulton), occupied the chair, while the vice-chairs were filled by Mr. G. C. Druce, M.A., Mr. H. M. J. Underhill, and Professor Hillhouse (Birmingham). At the close of the luncheon,

Professor Hillhouse rose and said he believed that that would be the last occasion upon which they would all meet together, and, therefore, it would be the last opportunity they would have of offering to their hosts the tribute of their thanks—(applause). As to the merits of their hosts, he hardly thought that any words of his could possibly paint them in fitting aspect. They had seen them as business people; they had had them as their guides in their various pleasant occupations during the preceding twenty-four hours, and many had appreciated their hospitality in more private capacity. He ventured to say that in no previous meeting of that Union—certainly no meeting for the last eight or ten years—had the duties of hosts been attended to with so much assiduity or with so much success as on the present occasion. He asked those present, as representatives of the Midland Union of Natural History Societies, to accord to the Oxford Society a most hearty vote of thanks for their kindness and courtesy, and

the incessant attention which they had shown the visitors during the meeting—(applause)—and to couple with the toast the names of Mr. Poulton and Mr. Underhill.

Mr. W. R. Hughes, F.L.S. (Birmingham), seconded the vote, which was most cordially received.

Mr. Poulton returned hearty thanks on behalf of the Oxford Society for the kind way in which the visitors had spoken of them, and said it had been a very great pleasure to the Society to see those from a distance among them. He felt that the Union had a very great work to do, and thought that Natural History Societies made a great mistake in very often thinking that they could do better work themselves than by joining a Union like theirs. He deprecated the use of so many organs in which the doings of Natural History Societies were made known, and said that a few good magazines should contain the work of all the Natural History Societies of the country. He thought it was an advantage for Societies to combine, and that their Union did an admirable piece of work in leading such a combination. In conclusion, he wished to express in the name, he was sure, of all present their most sincere and hearty thanks to the Dean of Christ Church for lending them the use of the Hall on that occasion—(applause). He (the speaker) thought it was most appropriate that their Society should meet and have lunch in the first Hall in Oxford, and when the Dean of Christ Church was approached on the subject he very kindly consented at once to their having the use of the Hall—(applause).

Mr. H. M. J. Underhill also returned thanks, and seconded the motion, which was unanimously agreed to, and the proceedings closed.

In spite of the ceaseless drizzle, parties were now made up under local guidance to visit some of the lions of Oxford. Thus a number, under the guidance of Mr. Poulton, proceeded to the Hall and Chapel of Magdalen College, and thence to the Botanical Gardens on the opposite side of the road. where Mr. Farmer, assistant to Professor Vines, was present throughout the afternoon. Some again visited the Pitt-Rivers Collection, where Mr. Balfour again explained the most interesting features; others the Hope Collection of Insects, under the guidance of the Rev. J. W. B. Bell. The Bodleian Library was open from two to four p.m., the Bodley

Librarian, Mr. E. W. B. Nicholson, M.A., kindly giving a short history of the Library, and the Camera was also open throughout the afternoon. The Clarendon Press was visited by a party, and the processes of electrotyping were illustrated. The Radcliffe Observer, Mr. E. J. Stone, M.A., F.R.S., kindly consented to show the instruments, &c., at the Radcliffe Observatory, to one party at three p.m., and another at four p.m. The Radcliffe Observer and Mrs. Stone very kindly invited both parties to tea at four p.m. A small party visited Dr. J. A. H. Murray's Scriptorium, in which the great dictionary is being prepared. To some extent these afternoon parties were interfered with by the weather, but the aggregate attendance at them was larger than might have been expected, and no doubt satisfied the various hosts that the courtesy they were showing to their visitors by no means fell upon thankless soil.

We cannot conclude this brief report without congratulating the Union upon a most brilliant and successful meeting, and giving hearty expression to the indebtedness of the members, in the first instance, to Mr. Poulton, President. and Mr. H. M. J. Underhill, Secretary, of the Oxford Society, to whose constant and thoughtful care so much of the success was due; and after them to the various members of the Reception Committee, and to those who, in more private way, added by their hospitality to the comfort and pleasure of the visiting members,

Review.

A Contribution to the Flora of Derbyshire. By the Rev. W. H. PAINTER. 8vo, pp. 156. Map. London: G. Bell and Sons. Price 7s. 6d.

THE preface of this new Flora is short, and gives little explanation of the work itself or the reasons which induced the author to publish it in its present form. The introduction contains only a meagre reference to the geology of the district and a sparse description of the topographical divisions and of the river systems of Derbyshire. In the recent Flora of South-West Yorkshire, by Mr. F. Arnold Lees, these portions have been so completely treated as to render it difficult indeed to follow him, while it raises the standard by which we must judge such books. Surely the geology of Derbyshire and its influence on plant distribution can scarcely be dismissed in thirty-two lines! The various classes of citizenship of plants are then enumerated, the author using them in the same sense as in Watson's Cybele.

They are given as follows in the Flora, and compared with the British list :—

	Britain.	Derbyshire.
British	532	532
English	409	282
Germanic	127	14
Highland	120	9
Scottish	81	30
Atlantic	70 .. .	3
Intermediate	37	16
Local	49	3
	1,425	889

Here there must be some error, as it is not probable that Derbyshire contains all the British types. It is likely that 800 would more correctly represent the total number of Derbyshire plants apart from aliens.

The zones of temperature and altitude are given verbatim from Baker's Lake District Flora. No notice is taken of the meteorology of the county.

The bibliography of Derbyshire is appended, but it is by no means exhaustive. No reference is made of Parkinson, although a Derbyshire station is recorded in the *Theatrum*, nor of the Phytologia Britannica, notwithstanding Wm. How there includes "*Ononis* var. *albo* neere Derby," and of "*Jacea sive Herba Trinitatis elegantis flore luteo amplissimo* neere Edenhole in the Peeke, and about Buckstone," nor of Merrett's Pinax, in which the two latter records are quoted. The list of recent workers appears more complete, and contains valued names, such as Bloxam, Churchill, Babington, J. G. Baker, W. H. Purchas, W. R. Linton, &c.

The list of Derbyshire plants then follows, the nomenclature employed being that used by Mr. J. G. Baker in the Lake District Flora, but it would have been preferable to follow, at any rate, the sequence of the London Catalogue, based as that is on Bentham's and Hooker's Genera Plantarum. Our nomenclature, it is true, is at present by no means fixed, and pending the issue of some authoritative work the adoption in its entirety of the names used in the London Catalogue is a matter for consideration. At any rate, important works such as the Floras of South-West Yorkshire, Hereford, and Suffolk have kept on the old lines, which, incorrect as they doubtless are in many cases, have at least the doubtful merit of custom to account for their retention. There can be no use, however, in the perpetuation of such errors as *Galium cruciatum*, Linn., *Trifolium ochroleucum*, L., *Bryonia dioica*, Linn., *Alnus glutinosa*, L., *Rumex Hydrolapathum*, Huds., &c. These should read *Galium Cruciata*, Scop., *Alnus glutinosa*, Gaertn., *Bryonia dioica*, Jacq., *Trifolium ochroleucon*, Huds., *Rumex Hydrolapatheum*, Huds.

There are also certain rules for citation which it is desirable to follow. (The writer may take this opportunity of pleading for forgiveness for his own sins of omission and commission.) For instance, a capital must be used for any specific name which pre-Linnæan writers had used as an appellative or in a generic sense. For instance, we should write *Scabiosa Succisa*, L., *Anthyllis Vulneraria*, L., *Lysimachia Nummularia*, L., *Andromeda Polifolia*, L.

The use of varietal names again is by no means correct. Very many plants described as species have their author's name attached, as though they had called them varieties, *e.g.*, under Rosa, *var. subgloba*, Sm., *var. glauca*, Vill., &c., were originally described as species, and called *Rosa subglobosa*, Sm., *Rosa glauca*, Vill. It is more correct, therefore, to write *var. subglobosa* (Sm.) or *var. R. subglobosa*, Sm. The more correct way being to use the first varietal name by which it was called and its author; thus—var. *subglobosa*, Baker.

Here, too, we must express our regret that so little attention has been paid to the critical forms or even well marked varieties, nor is the distribution of the species at all thoroughly worked out. For instance, under *Chara vulgaris* two localities are given. Is it such an extremely rare plant in Derby?

Many of Mr. Purchas's notes are extremely interesting. So, too, are the remarks upon *Salix undulata*, by Dr. Buchanan White. Ehrhart, not Ehrhardt, and Döll, not Döle, are the correct names for the two botanists mentioned in it; and, later on, Hackel is mispelled Haeckel. It is the botanist, not the philosopher, who described the *Festuca* variety *capillata*, which had, however, a previous name, Gaudin having called it *var. paludosa* in the Flora Helvetica.

Under *Salix fragilis*, L., a variety *britannica* is given, but no reference is made to Dr. Buchanan White, nor is any synonym of the species itself given, so we are left uncertain as to whether the record refers to *S. viridis*, Fries, or to *S. Russelliana*, Sm.

Under *Melampyrum pratense* L., *var. ericetorum*, D. Oliver, is given. Has this been seen by Mr. Painter or any competent botanist?

"Topographical Botany" is frequently the only authority given for the occurrence of a species in the county. This is not very satisfactory. It would have been by no means difficult to have obtained Mr. Watson's authority for their insertion in that work. Take, for instance, "*Cephalanthera grandiflora*, Bab." (or, as it should be called, *C. pallens*, Richard, = *C. grandiflora*, S. F. Gray), Mr. Painter gives "Top. Bot. No authority." In the list of books quoted as used for the purpose of compiling the Flora, Mr. Painter includes the New Botanists' Guide, by Mr. Watson, and the Botanists' Guide, by Turner and Dillwyn. The plants in the latter book, Mr. Painter states, were taken from Pilkington's Account of Derbyshire. On referring to

Watson's Guide, we find *Epipactis grandiflora* [*Cephalanthera grandiflora*] recorded for Newton Wood, on the authority of B. G., which, teste Mr. Painter, was derived from Pilkington. So, too, with *Gentiana Pneumonanthe*, where Egginton Heath is given on the same authority; and so, too, with *Chlora perfoliata*, Pleasy Park and Whitewell being given as localities. Under *Mentha Pulegium*, we are told it is queried in Top. Bot., whereas in the Bot. Guide it is recorded from Pinxton, Ockbrooke, Radbourne, and Langley Commons.

Even under such a typical Derbyshire plant as *Polemonium*, some of the records in the New Botanists' Guide do not appear to be given. Such are Lover's Leap, near Buxton; rocks in the Winnets, near Castleton; Alfreton Brook, Bakewell Meadow. These are rather serious omissions, as the chance of verifying the doubtful records (if they are such) is to give in what is described as a County Flora all the available information respecting them.

These remarks must not prejudice the reader against the book. Such is not by any means the intention of the writer, for, so far as it goes, the Flora is a correct summary of the more recently published records of Derbyshire plants, placed before us in a compact, well-printed form. We only regret that having spent, as Mr. Painter must have done, so much labour (how much only those who have attempted a similar work can rightly appreciate) upon the book, he had not delayed its publication a little longer, so as to have made it more thoroughly representative of the interesting county it deals with. This, we hope, he will yet find time to do. Till then British botanists must thank him for temporarily filling up the gap in our list of County Floras.

The few following records of Derbyshire plants are taken from MSS. in a copy of the Dillenian Ray, in Library of Oxford Botanical Garden :—

Draba muralis, Castleton, Matlock, Mr. Yalden.
Cochlearia anglica, Hill, near Castleton, Mr. Yalden.
Thlaspi alpestre, Matlock, Mr. [Sir Jos.] Banks.
Cardamine impatiens, Matlock, Mr. Banks and Sir. Jno. Cullum; Middleton Dale, Duchess of Portland.
C. bellidifolia, near the edge of Derbyshire, Mr. Bolton.
Polemonium cœruleum, near Castleton, Mr. Banks; Alfreton Brook, Dr. Oaks.

G. C. Druce.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Annual Conversazione was held at the Mason College, on Tuesday, October 29th; 174 members and friends were present. A

unique and beautiful collection was exhibited of coloured drawings of British shells, "Gibsone's Conches," made by the late George Gibsone, of Newcastle, and shown by his grandson, Rev. B. W. Gibsone, of Hinckley, who kindly came over for the purpose. Mr. E. Catchpool, of Sheffield, showed, in action, a series of very interesting and ingenious models of his own design and construction, illustrating the mode of flight of birds and insects; also specimens of ants' nests, showing the ants at work, which he had kindly brought from Sheffield for the Conversazione. Councillor Clayton contributed a fine series of photographs of Ceylon, India, Japan, Algeria, and the Yosemité Valley, which he had brought home in his recent travels; and a complete model of a Japanese house. Mr. F. Shrive exhibited twenty-four cases of British Lepidoptera, collected in the neighbourhood by himself. Mr. W. H. Wilkinson exhibited a number of cases of butterflies and moths, collected by himself in England and Scotland. Mr. W. R. Hughes exhibited a very unique and beautiful specimen of red coral, *Corallium rubrum*, showing the polypes expanded, which had been obtained from 1,000 feet depth in the Mediterranean, near Naples; also specimens of *Amphioxus lanceolatus* and an Ascidian. Mr. R. W. Chase exhibited a series of specimens of British Corvidæ; also a new British bird, *Emberiza cioïdes* (Brandt's Siberian Bunting), obtained at Flamborough Head, November, 1886, which is the only known European specimen, the bird being a native of Siberia. Mr. C. Pumphrey exhibited a living specimen of a young gull, and an adult bird that had been lent by Mr. Chase for the purpose. Dr. Saukey, of Oxford, contributed specimens of the curious nest of the Trap-door Spider, from Italy (the Riviera). Professor Bridge exhibited a collection of British shells, recently presented to the College, that were arranged in very complete series from youngest to oldest of each kind. Mr. E. F. Spicer exhibited a fine group of badgers, and specimens of birds. Mr. J. B. Stone exhibited a portion of an extensive and valuable collection of dried plants that he had obtained in different parts of Europe. Mr. J. H. Jaques exhibited an interesting series of Norway photographs on glass lantern-slides, taken in a recent visit by himself; and a number of photograph lantern-slides were exhibited by Mr. C. Pumphrey, Mr. C. J. Watson, Mr. J. Edmonds, and Mr. C. Mantell, including many beautiful photographs of flowers. A large collection of microscopes was exhibited by members of the Society, showing various Natural History objects. The President, Mr. W. B. Grove, M.A., exhibited a collection of fungi from the neighbourhood, and contributed to the refreshments a large dish of cooked Oyster Mushroom (*Agaricus ostreatus*), served with a gravy from *Coprinus comatus* and other selected fungi, which was partaken of by the company. The room was decorated with plants kindly lent by Mr. Spinks, of Messrs. Hewitt's Nursery, Solihull.—BIOLOGICAL SECTION, November 12th; Mr. Charles Pumphrey in the chair. Mr. Thos. E. Bolton exhibited and described *Amphioxus lanceolatus*, the Lancelet, the lowest form of vertebrate animals. This curious fish is devoid of skull and bones, the vertebral column being represented by an unjointed rod of cartilage extending the full length of the body.—MICROSCOPICAL SECTION, November 5th; Mr. W. P. Marshall, M.I.C.E., in the chair. Mr. J. E. Bagnall, A.L.S., exhibited a very rare fungus, *Cantharellus radicosus*, grown on charcoal, from Crowell, Oxon. Mr. W. H. Wilkinson then read a paper on "Growing Cells for Use with the Microscope." He exhibited the glass cells and apparatus used for the constant supply of water and air to enable the student to watch the development of minute organisms through all their stages, without

the necessity of ever disturbing or retarding the objects under observation during the whole time of their culture. His remarks were further illustrated by diagrams. A discussion was afterwards held in which Messrs. J. E. Bagnall, J. Edmonds, G. M. Iliff, and others took part.—SOCIOLOGICAL SECTION, November 14th. Mr. F. J. Cullis gave an able exposition of the first three chapters of Mr. Herbert Spencer's "Principles of Sociology" to a large and appreciative audience, which was followed by an interesting discussion in which many of those present took part.—GEOLOGICAL SECTION, November 19th; Mr. T. H. Waller, B.A. B.Sc., in the chair. There was a very large attendance, 250 being present, to hear a paper by Messrs. R. W. Chase and Pumphrey on "A Trip to the Norfolk Broads." The paper was largely illustrated by photographs of especial interest, taken by Mr. C. Pumphrey during the excursion. The views included many cathedrals, and other buildings archæologically interesting, various birds' nests, with their natural surroundings, scenes on the Broads, and two very special views of a decoy for wild duck, taken at Fritton, together with a photograph of Mr. Thomas Page, the keeper. The lecture was given in the Examination Hall, Mason College. At the close a vote of thanks to the two gentlemen above-named was carried with acclamation.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 16th. Mr. Deakin exhibited a collection of land shells from Cape Finisterre, and pointed out the very small differences between them and English types; Mr. J. W. Neville, Lady's-mantle Rust (*Uromyces intrusa*): Mr. J. Madison, specimens of *Limnæa auricularia* var. *reflexa*, from King's Norton. Under the microscope Mr. J. Moore showed palate of *Cochlicopa tridens*; Mr. H. Hawkes, *Aphis populi*.—September 23rd. Mr. H. Hawkes showed under the microscope preparations of *Erica tetralix* and *E. vulgaris*, showing pollen, glandular hairs, and pouch-like anthers; Mr. J. Collins *Chætophora endiviæfolia*, a freshwater alga, from Sutton Park; Mr. Parker, cyclosis in *Nitella translucens*.—September 30th. Mr. Deakin exhibited specimens of *Typhis pungens* and other shells from the Eocene formation of Barton Cliff; Mr. J. Madison, a short spired variety of *Limnæa stagnalis*, from Milford. Under the microscope Mr. H. Hawkes showed a rare seaweed, *Naccaria Wigghii*, and a section through a flower-bud of horse chestnut.—October 7th. Mr. J. W. Neville exhibited specimens of "coal balls," and sections of the same material showing fossil plant structure, notably transverse sections of fern stems; Mr. J. Madison, wing of fossil insect from rhætic bed, Knowle; Mr. Lassita, a series of Silurian fossils from Aldridge; Mr. T. H. Waller, specimen of band of diorite, showing the line of contact with the Stockingford shale, from Nuneaton; Mr. J. Moore, a section of coral, *Cyathophyllum reticulatum*; Mr. H. Hawkes, tail of rattlesnake; also the following fungi: *Nectria cinnabarina*, *Peziza cyathoidea*, and a mould on *Trichia varia*. Mr. Camm, *Alwisia intermedia* and *Hemiarcyria* sp.—October 14th. Mr. H. Hawkes showed fasciated stem of asparagus. Mr. J. W. Neville then read a paper, "Notes on the Ovipositors of Insects." The writer said it might be thought an ovipositor need only be a very simple contrivance, a tube (perhaps telescopic, to enable it to be withdrawn into the insect's body when not in use) through which the eggs might pass from the ovary to their destination. This was all we found in some insects, but in others the ovipositor and its contingent organs grew very complicated. The

various orders of insects were then reviewed at some length, the peculiarities of each being described. Of all orders the Hymenoptera gave the most numerous instances of specialised forms. The paper was illustrated by a series of drawings.—October 21st. Mr. J. W. Lassetter exhibited a series of specimens of *Atrypa reticularis*. showing various stages of growth. Mr. H. Hawkes, mounted specimens of our rarer plants, including *Sibthorpia europæa*, *Neottia æstivalis*, *Silene acaulis*, *Dianthus cæsius*, *Lobelia urens*, &c., and, under the microscope, stellate hairs on corolla of *Corea preciosa*.—October 28th. Mr. Camm exhibited, under the microscope, the following fungi: *Hemiarcyria rubiformis*, *H. Serpula*, and *Craterium aureum*, the two last from Carlisle. Mr. Thompson then read a paper, "Notes on the Crayfish." The writer, in describing the life history of this crustacean, said that though they were little esteemed by us as an article of food, yet on the Continent they were in great request, the demand for them in France exceeding the supply. After speaking of their habits in summer and winter and the different methods employed in taking them, the writer dealt at some length on the normal and abnormal development of their swimmerets, mouth organs, antennæ, antennules (containing organs of hearing), gills, bronchial chamber, heart, stomach and gastroliths within it. The paper concluded with an account of their method of reproduction. The subject was illustrated by a series of drawings and dissections.—November 4th. Annual Meeting for election of officers, &c. The General Secretary, Secretary of Committee, Curator, and Treasurer presented their reports, the latter stating that there was a balance of £3 17s. 5d. in favour of the Society. On the motion of Mr. White, the reports were adopted. Mr. T. H. Waller, B.A., B.Sc., the retiring President, proposed Professor Hillhouse, M.A., F.L.S., as President for the ensuing year. Messrs. C. P. Neville and J. Edmonds seconded and supported the nomination, which was carried unanimously. The President said it gave him great pleasure to accept the post. Although he could not hope to attend all the meetings of the Society, still he trusted to be able to take a useful part in it. The Society was performing an unassuming work, which it was a pleasure to read of from month to month, and he would do what he could to help forward and further its best interests. The following officers were then elected: Messrs. Deakin and Corbet, Vice-Presidents; Mr. J. Collins, General Secretary; Mr. White, Secretary of Committee; Mr. Madison, Curator. The other officers were re-elected. The election of Committee and vote of thanks to retiring officers brought the meeting to a close.—November 11th. Mr. H. Hawkes exhibited specimens of *Osmunda regalis*, *Ophioglossum vulgatum*, and *Botrychium Lunaria*, our only native examples of exannulate ferns. Mr. P. T. Deakin then read a paper on "The Country around Christchurch, Hants." The writer described the situation of the town, and referred to its history and antiquities. It was once a seaport, but the harbour has been silted up until no large vessels can enter it. The great charm of this district to the scientist is its geology, for it gives us in the space of a few miles an almost complete section from the lower to the upper Eocene. In the Bournemouth beds we find leaf impressions and the remains of tree trunks, the latter bored through and through by a marine mollusc. Although some organic remains are to be found nearly all along the coast line, yet it is only when we come to Barton Cliff that they really abound. The writer gave lists of the fossils found commonly, and also referred to those less frequently met with, and said great interest